OPERATING AND SERVICE MANUAL

ELECTRONIC COUNTER

5216A

HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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ELECTRONIC COUNTER
5216A

SERIAL PREFIX: 948-

This manual applies directly to HP Model 5216A Electronic Counters having serial prefix number 948.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 948, a "Manual Changes" sheet is included with this manual. For serial prefixes below 948, refer to Section VII, Manual Changes.

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

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MANUAL CONTENT

This manual is supplied to help you make best use of your instrument. The manual covers 8 sections of information as follows:

Section I is an introduction to the instrument. Electrical specifications are given, plus information on accessories.

Section II covers inspection, power, mounting, packing, shipping and connection.

Section III outlines operating procedures.

Section IV discusses technical details of circuit operation.

Section V provides performance check, troubleshooting and adjustment procedures.

Section VI lists replaceable parts.

Section VII gives information on manual changes.

Section VIII contains circuit diagrams with component location.

HOW TO ORDER

To order an operating and service manual, contact your nearest Hewlett-Packard Sales and Service office. Give complete model, name and 8-digit serial number. The serial number plate is on the rear panel (see Paragraph 1-7 for serial number system). Comments on this manual are welcome at any Sales and Service Office.

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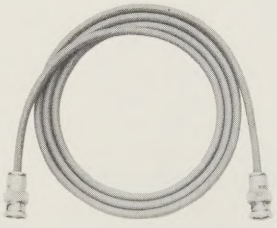
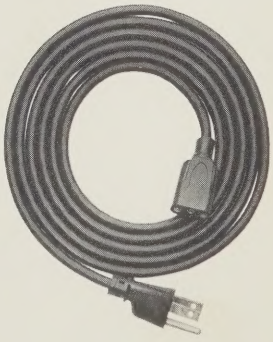
Figure 1-1. Model 5216A and Accessories

MODEL 5216A

BNC TO BNC CABLE



POWER CORD



SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The Hewlett-Packard Model 5216A is a 12.5 MHz Electronic Counter that makes frequency measurements, period measurements, period average measurements, ratio measurements, totalizing and time interval measurements. All electrical and mechanical specifications are given in Table 1-3. The HP Model 5216A provides these additional features:

a. Standard output frequency of 1 MHz.

b. Display storage permits readings to be displayed while new count is being made.

c. Blanking feature suppresses the display of unwanted zeros when storage is on.

d. Seven digit display using digital display tubes; decimal point position and measurement units displayed automatically.

e. Four-line BCD code output of 1248 "1" state positive provided for use with digital recorder.

f. Remote reset control is available through rear panel BNC with contact closure to ground.

1-3. EQUIPMENT SUPPLIED

1-4. Equipment supplied with the Model 5216A is listed in Table 1-1.

1-5. ACCESSORIES AVAILABLE

1-6. Accessories available for the Model 5216A are listed in Table 1-2.

1-7. INSTRUMENT IDENTIFICATION

1-8. Each Model 5216A is identified by a two-section, eight digit (000-00000), serial number on the rear panel. The five digit number is an identification number unique to each instrument, and the three digit number is a serial prefix number used to document changes.

1-9. The title page of this manual lists the serial prefix number to which this manual directly applies. For newer instruments, if the serial prefix number is different from that which is listed on the title page, a manual change sheet will be included, describing the required changes. The manual for an instrument having special electrical modifications will include an insert sheet describing that modification. If a change sheet or special information sheet is missing, the information can be supplied by any Hewlett-Packard Sales and Service office listed at back of this manual.

Table 1-1. Equipment Supplied

Description	HP Part No.
Detachable power cord: 7-1/2 feet (231 cm) long, NEMA plug	8120-0078
Cable: 4 feet (122 cm) long, male BNC connectors	10503A

Table 1-2. Accessories Available

Description	HP Part No.
Digital Recorder	5050A
Recorder interconnecting cable	10513A
Rack Mount Adapter Frame	5060-0797
Combining Case	1052A

Table 1-3. Model 5216A Specifications

FREQUENCY MEASUREMENT

Range: 3 Hz to 12.5 MHz.

Input: 10 mV rms sine wave, max. sensitivity. Approx. 1 MΩ shunted by 50 pF input impedance.

Gate Times: 10, 1, 0.1, 0.01 s.

Accuracy: ±1 count ±time base accuracy.

Readout: 7 long-life Nixies®, reads in MHz and kHz with positioned decimal point.

TIME INTERVAL MEASUREMENT

Range: 10 μs to 10 s.

Input: Contact closure or saturated NPN transistor to ground. Signal duration ≥ 1 μs. Current sinking ≥2 mA. The START signal must end before the STOP signal begins. Time from STOP to next START: ≥30 ms for external reset or ≥ 30 ms plus sample time for internal reset.

Frequency Counted: 1 MHz internal time base or external frequency standard.

Readout: ms with positioned decimal point.

PERIOD MEASUREMENT

Range: 3 Hz to 1 MHz single period; to 2 MHz in multiple periods averaged.

Periods Averaged: 1, 10, 10^2, 10^3, 10^4, 10^5.

Input: 10 mV rms maximum sensitivity; 100 mV rms below 1 kHz.

Frequency Counted: 1 MHz internal time base or external frequency standard.

Accuracy: ±1 count ±time base accuracy ±trigger error*.

Readout: ms and μs with positioned decimal point.

RATIO MEASUREMENT

Displays: (f_1/f_2) x period multiplier; multipliers: 1, 10, 10^2, 10^3, 10^4, 10^5.

Range, Sensitivity: f_1: 1 kHz to 10 MHz into external time base BNC connector, 1V rms min. into 1000Ω. f_2: 3 Hz to 1 MHz single period, to 2 MHz in multiple periods averaged, 10 mV rms sens. except 100 mV rms below 1 kHz.

Accuracy: ±1 count of f_1 ±trigger error of f_2*.

TIME BASE

Crystal Frequency: 1 MHz.

Stability: Aging Rate: less than $\pm 2 \times 10^{-6}$/month. Temperature: less than $\pm 1 \times 10^{-5}$ from +15°C to +35°C; less than $\pm 3 \times 10^{-5}$ from 0°C to +50°C. Line Voltage: less than 1×10^{-6} for ±10% change.

Output Frequency: 1 MHz, 3V p-p min. open circuit; source impedance is 2000 ohm maximum.

External Std Input: 1 MHz sine wave, 1V rms into 1000 ohm (10V rms maximum).

GENERAL

Display: 7 digits, long-life Nixies®.

Display Storage, Blanking: Yes

Sample Rate: 50ms to 5s or hold until manual reset.

Reset: Manual by pushbutton or remote, activated by contact closure or saturated NPN transistor to ground on rear panel BNC connector.

Signal Input:
- Sensitivity: 10 mV rms sine wave, maximum sensitivity; 30 mV peak pulse, minimum pulse width 40 ns.
- Impedance: Approx. 1 MΩ shunted by 50 pF.
- Attenuation: Step attenuator, 0.01, 0.1, 1, 10V settings.
- Trigger Level Adjustment: Continuously variable trigger level control.
- Overload: Input voltage should not exceed 60 dB above attenuator setting or 300V rms (damage level).

Self Check: Works on all functions.

Digital Output:
- Code: 1248 "1" state positive; "0" level: 0V nominal; "1" level: +5V open circuit, nominal; source impedance: 7.5KΩ max. each line.
- Reference Levels: Ground; +5V, low impedance.
- Print Command: Step from 0V to +5V dc coupled.
- Hold-off Requirements: Voltage must be between -10V and -15V.
- Chassis Connector: Accepts HP Cable 10513A with one special connector for the 5216A and one 50-pin Amphenol or Cinch type 57-30500-375, HP Part No. 1251-0086, male connector for HP 5050A Digital Recorder.

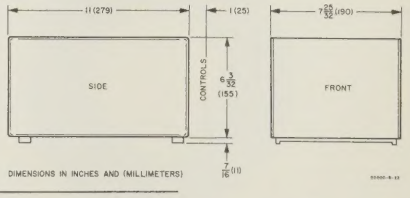
Operating Temperature Range: 0°C to +50°C.

Power Requirements: 115/230V ±10%, 50 to 400 Hz, 20W maximum.

Weight: Net 7 lbs (3,1 kg); shipping 8-1/2 lbs (3,9 kg).

Accessories Furnished: HP 10503A, 4 feet, 50Ω cable, BNC connectors. Detachable power cord, 7-1/2 feet (231 cm) long, NEMA plug.

Dimensions:



* Trigger error for 10 mV rms sine wave input is less than $\frac{\pm 0.3\% \text{ of one period}}{\text{periods averaged}}$ for signals with 40 dB signal-to-noise ratio. Decreases with increased signal amplitude and slope.

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SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (dents, scratches, broken knobs, etc.). If the instrument is damaged or fails to meet specifications, (Performance Check, Paragraph 5-9), notify the carrier and the nearest Hewlett-Packard Sales and Service office immediately (offices are listed at the back of this manual). Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

2-3. STORAGE AND SHIPMENT

2-4. To protect valuable electronic equipment during storage or shipment always use the best packing methods available. Your Hewlett-Packard Sales and Service office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

2-5. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq. in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of instrument. Insert fillers between pads and container to ensure a firm fit.

2-6. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq. in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of instrument.

2-7. ENVIRONMENT. Conditions during storage and shipment should be limited as follows:

a. Maximum temperature: +167°F (+75°C).

b. Minimum temperature: -40°F (-40°C).

2-8. RACK INSTALLATION

2-9. When instrument is to be rack-mounted, a combining case (Paragraph 2-10) or adapter frame (Paragraph 2-11) is required. These items are available through the Hewlett-Packard Sales and Service offices. The following two paragraphs outline the two methods for rack-mounting the instrument.

2-10. COMBINING CASE. The combining case (HP 1052A) shown in Figure 2-1 is a unit which accepts two instruments of 5216A size. The combining case can be used as a bench model or it can be rack mounted. A rack mounting kit (HP Part No. 5060-0777) is supplied with the combining case. Instructions for using the case are given in Figure 2-1. When only half the case is used, a blank filler panel (HP Part No. 5060-0794) is available to enclose the unused half.

2-11. ADAPTER FRAME. The adapter frame (HP Part No. 5060-0797) in Figure 2-1 is a rack frame that accepts two units of 5216 size. It can only be rack mounted. Install instruments in the adapter frame as follows:

a. Place adapter frame on edge of bench as shown in step 1 of Figure 2-1.

b. Stack units in frame as shown in step 2. Place spacer clamp between units, step 3.

c. Place two end spacer clamps (step 4) and push units into frame.

d. Insert screws on either side of frame, step 5, and tighten until units are tight in frame. The complete assembly is now ready for rack mounting.

2-12. FILLER PANELS

2-13. When only a portion of a combining case or adapter frame is used, blank filler panels are available to enclose the unused portion. Table 2-1 outlines filler panels available.

Table 2-1. Filler Panels Available

Dimensions	HP Part No.
6-3/32" high, 2-31/64" wide	5060-0795
6-3/32" high, 5-1/8" wide	5060-0793
6-3/32" high, 7-25/32" wide	5060-0794
3-1/32" high, 7-25/32" wide	5060-0097

2-14. OPERATION FROM 115 OR 230 VAC

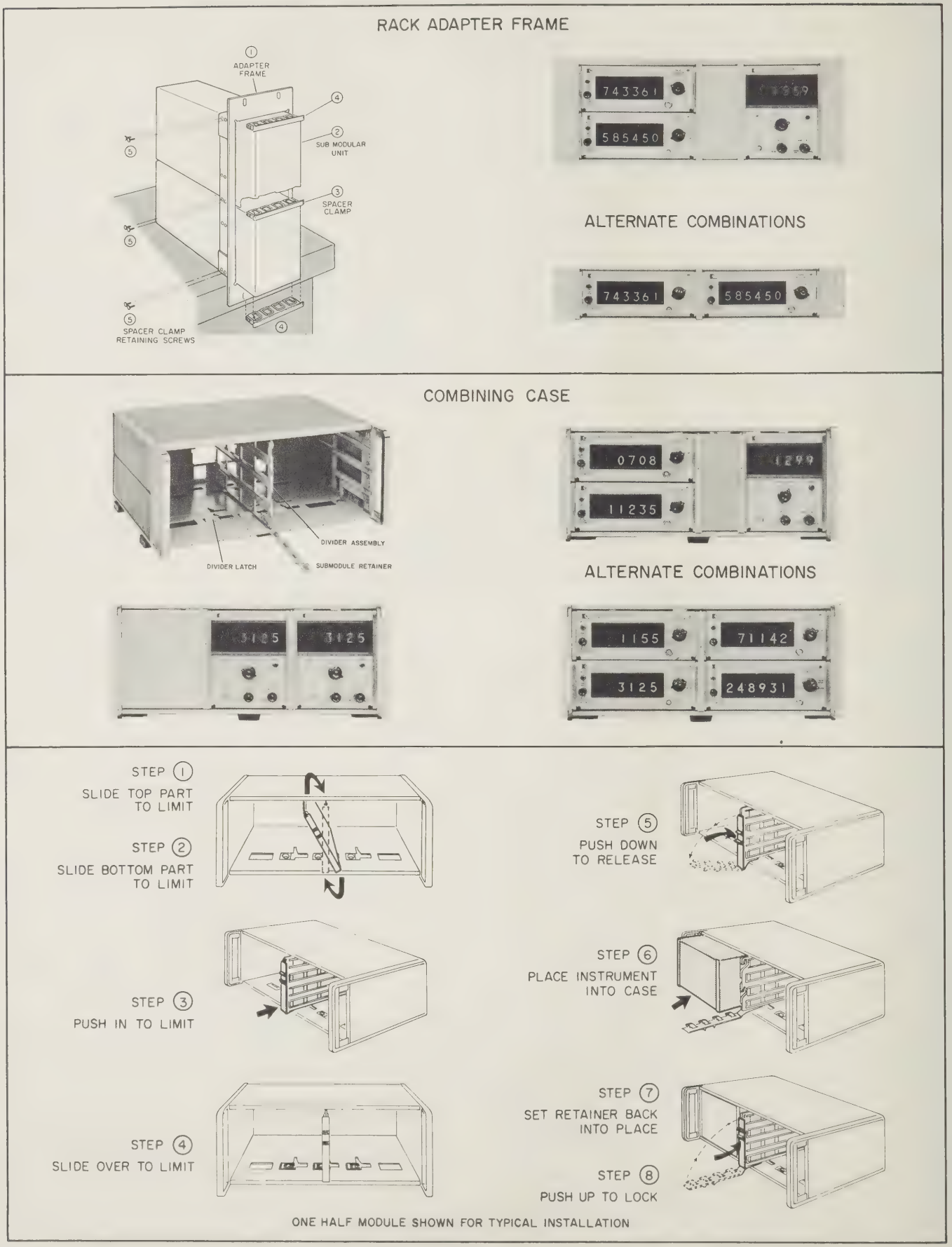
2-15. GENERAL. The instrument can be operated from either 115 or 230 Vac (±10%, 50 to 400 Hz) power lines. A rear panel slide switch permits operation from either voltage. Insert a narrow blade screwdriver in the switch slot and slide the switch to expose "115" marking for 115 volt operation or "230" marking for 230 volt operation. The ac line fuse is 0.3 for 115V and 0.15 for 230V operation.

2-16. POWER CONNECTION. The instrument is supplied with a detachable 3-wire power cable. Install as follows:

a. Connect flat plug (3-conductor female connector) to the ac line jack at the rear of the instrument.

b. Connect plug (2-blade male with round grounding pin) to 3-wire grounded ac outlet. Exposed portions of the instrument are grounded through the round pin on the plug for safety. When only a 2-blade outlet is available, use HP adapter 1251-0048 and connect short wire from side of adapter to ground.

Figure 2-1. Adapter Frame and Combining Case



SECTION III

OPERATION

3-1. INTRODUCTION

3-2. The HP Model 5216A measures frequency, period average, ratio of two frequencies, and total events. A switch selects both measurement functions and time base or multiplier. A SENSITIVITY switch adjusts instrument sensitivity, the SAMPLE RATE control sets the measurement cycle rate.

3-3. CONTROLS

3-4. Function Selector. This 12 position switch selects both measurement function and time base (gate time) or multiplier desired for the measurement.

3-5. SENSITIVITY Control. Adjusts instrument sensitivity. With proper settings, the counter will operate with input signals of .01 V rms (sine wave). A LEVEL control is incorporated in the SENSITIVITY switch. It provides trigger level adjustment for pulse input signals.

3-6. SAMPLE RATE Control. Sets the period of time following the gate closure until the gate may be opened again. With the counter in FREQUENCY mode, SAMPLE RATE is adjustable from approximately 0.05 sec (minimum) to at least 5 sec (maximum) and is independent of gate time. The HOLD position sets the display indefinitely.

3-7. RESET Pushbutton. When depressed, resets the display and internal count to zero. The counter after reset is ready to begin a new counting cycle.

3-8. STORAGE Switch. Disables the storage feature and controls zero blanking. The display storage feature provides a continuous visual display while the instrument is totalizing a new count. Only if the new count differs from the previous count will the display change. With storage on, a low level sets selected decades to zero at reset.

3-9. FREQ STD Switch. When this rear panel switch is set to INT, 1 MHz signal of the internal oscillator is available from the FREQ STD connector. When using an external frequency standard (or the higher of two frequencies for ratio measurement), set FREQ STD switch to EXT, and connect the external standard (or higher frequency signal) to FREQ STD connector.

3-10. FREQ-PER/TIME INT Switch. In FREQUENCY, PERIOD, or MANUAL, the switch should be in FREQ-PER position. To make time interval measurements, set switch to TIME INT. Connect start and stop control signals to START and STOP connectors on rear panel.

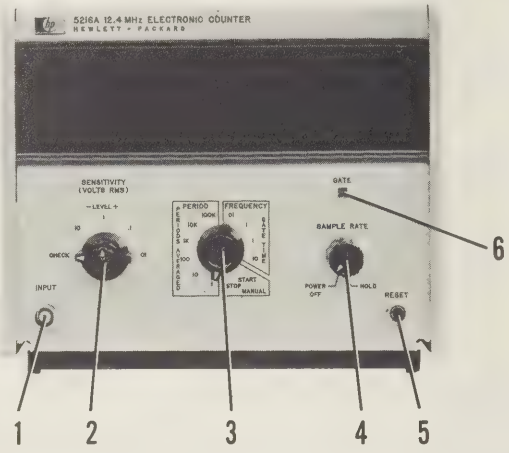
3-11. DIGITAL RECORDER OUTPUT

3-12. To supply counter display information to the HP Model 5050A Printer, use digital recorder interconnecting cable HP Part No. 10513A. The DIGITAL RECORDER jack will mate with 36-pin printed circuit connector A4J1 on the counter rear panel. Signals available and external signals required are given in Table 3-1. BCD output code is 1248, "1" state positive.

Table 3-1. Digital Recorder Jack Pin Connections

Function		A4J1 Pin No.
Display	Weight	
(Right End) 10^0 Units	1 2 4 8	17 16 15 18
10^1 Tens	1 2 4 8	6 7 8 5
10^2 Hundreds	1 2 4 8	F H J E
10^3 Thousands	1 2 4 8	R N M P
10^4 Ten Thousands	1 2 4 8	L 9 10 K
10^5 Hundred Thousands	1 2 4 8	11 13 14 12
10^6 Millions	1 2 4 8	S V U T
Print Command output; 0V to +5V step, dc coupled.		4
Inhibit signal input; must be between -10V and -15V.		2
+5Volts positive reference, indicates "1" level for BCD output.		3
Ground		1

Figure 3-1. Front Panel Controls and Connector



1. INPUT jack couples input signal to input attenuator.

2. SENSITIVITY

   a. Connects CHECK signal or attenuated input signal to input amplifier.

   b. LEVEL control adjusts input trigger level.

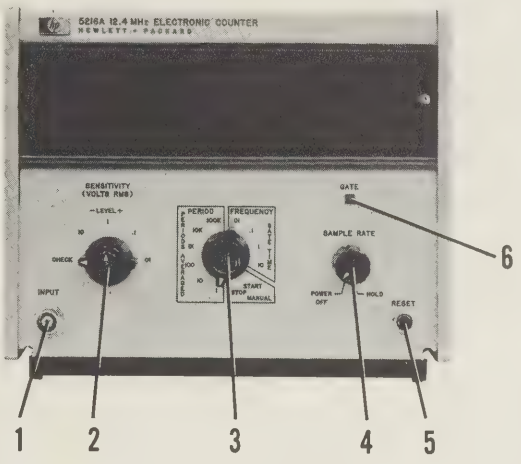
3. Function - Time Base switch - selects multiplier for PERIODS AVERAGED measurements, selects gate times for FREQUENCY measurements, and controls START and STOP for totalizing measurements.

4. SAMPLE RATE control turns counter on, holds display, and varies sample rate from 50 ms to 5 seconds.

5. RESET switch manually resets counter.

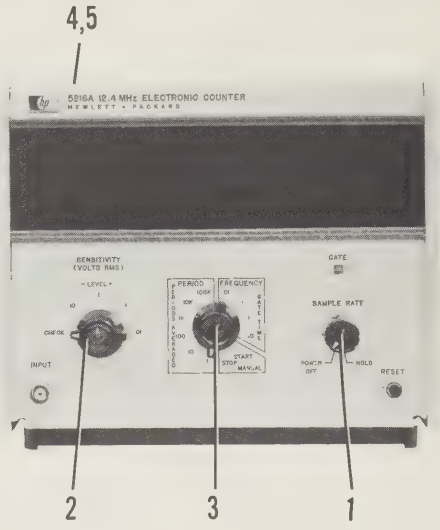
6. GATE light indicates gate open when light is on.

Figure 3-2. Rear Panel Controls and Connectors



1. DIGITAL RECORDER jack supplies BCD information to printer (see page 3-1).
2. AC LINE connector connects to flat plug on power cable.
3. Fuse provides overload protection.
4. Line Voltage switch selects either 115 or 230 Vac line; insert narrow blade and slide to right for 115V, slide to left for 230V.
5. STORAGE switch disables storage feature and controls zero blanking.
6. RESET jack provides remote reset of counter by contact closure to ground.
7. FREQ STD switch selects internal oscillator or external frequency standard.
8. FREQ STD jack provides 1 MHz output when internal oscillator is used; is input jack for 1 MHz external frequency standard.
9. FREQ-PER/TIME INT switch selects type of measurement, FREQ-PER or TIME INT.
10. START and STOP jacks control signal inputs for time interval measurements.
11. INPUT jack connected in parallel with front panel input jack.

Figure 3-3. Self Check

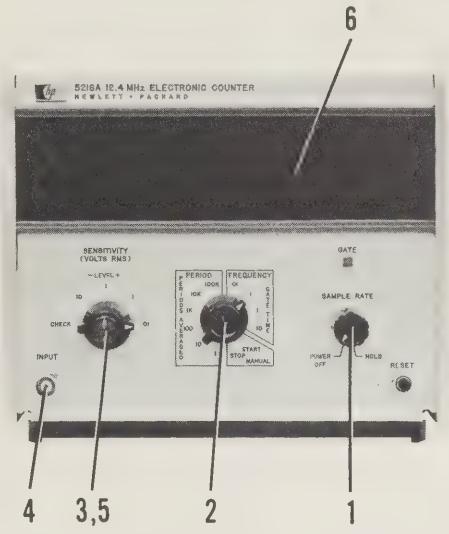


1. Set SAMPLE RATE control slightly clockwise out of POWER OFF.
2. Set SENSITIVITY switch to CHECK.
3. Set function selector to 1 PERIOD.
4. Set STORAGE switch to STORAGE.
5. Set FREQ STD switch to INT.
6. Adjust LEVEL control for stable count.

Position	Display
1 period	.001 ms
10 periods	.0010 ms
100 periods	.00100 ms
1K periods	1.000 μs
10K periods	1.0000 μs
100K periods	1.00000 μs
0.01 sec	1.0000 MHz
0.1 sec	1.00000 MHz
1 sec	1000.000 kHz
10 sec	000.0000 kHz

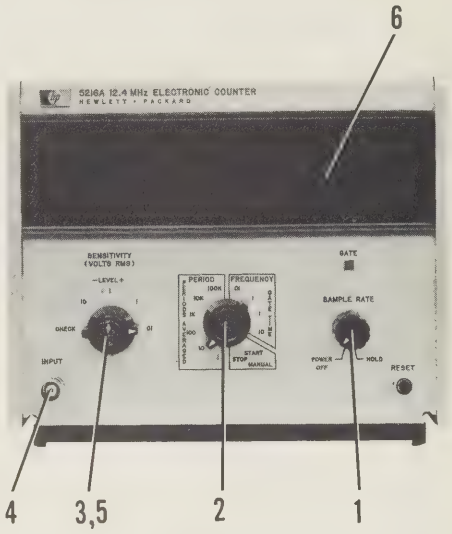
MANUAL START = continuous count at 1 μs rate
MANUAL STOP = continuous display of last count

Figure 3-4. Frequency Measurements



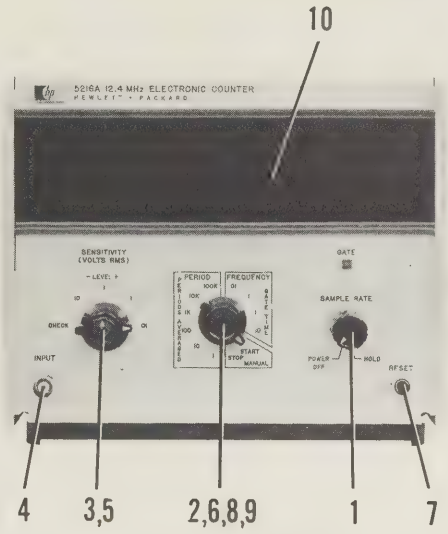
1. Turn SAMPLE RATE control clockwise from POWER OFF position to turn counter on.
2. Set function switch to desired FREQUENCY GATE TIME.
3. Set SENSITIVITY switch to CHECK to verify proper counter operation.
4. Connect unknown signal to the INPUT jack.
5. Change SENSITIVITY switch to 10; if there is no count or if count is uncertain, progressively set SENSITIVITY switch to lower ranges. Adjust -LEVEL+ control, if necessary, for proper triggering.
6. Read frequency from display. Decimal point is correctly positioned and correct measurement unit (kHz or MHz) is displayed.

Figure 3-5. Period Measurements



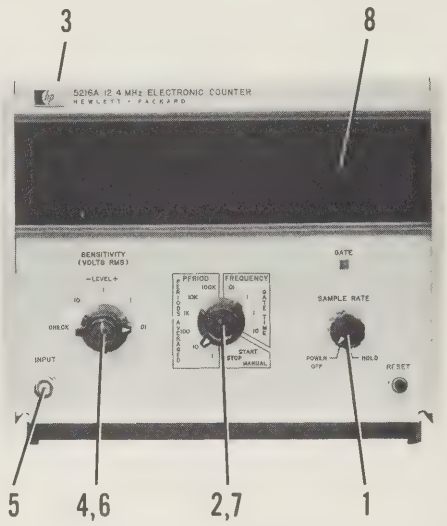
1. Turn counter on with SAMPLE RATE control.
2. Set function switch to desired PERIODS AVERAGED.
3. Set SENSITIVITY switch to CHECK to verify proper counter operation.
4. Connect unknown signal to the INPUT jack.
5. Turn SENSITIVITY switch clockwise to first position which gives steady count. Adjust -LEVEL+ control for proper triggering.
6. Read period from display; decimal point is correctly positioned and measurement unit (μs or ms) is displayed.

Figure 3-6. Totalizing Operation



1. Turn counter on with SAMPLE RATE control.
2. Set function switch to MANUAL START.
3. Set SENSITIVITY switch to CHECK to verify proper counter operation. Counter should count continuously at 1 μs rate.
4. Connect unknown signal to INPUT jack.
5. Change SENSITIVITY switch to 10; if there is no count or if uncertain, switch to lower ranges. Adjust -LEVEL+ control for proper triggering.
6. Set function switch to MANUAL STOP.
7. Reset count to zero.
8. At desired time to begin count, set function switch to MANUAL START.
9. At desired time to end count, set function switch to MANUAL STOP.
10. Read accumulated count from display.

Figure 3-7. Ratio Measurements



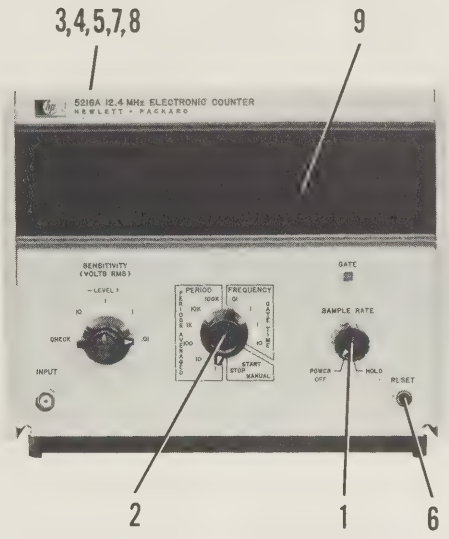
Proceed as follows to measure the ratio between two frequencies (f_1/f_2):

Higher frequency f_1 may be between 1 kHz and 10 MHz.

Lower frequency f_2 must be less than 1 MHz for single period and less than 2 MHz for multiple period measurements.

1. Turn counter on with SAMPLE RATE control.
2. Set function switch to desired PERIODS AVERAGED.
3. Connect higher frequency f_1 to FREQ STD connector on rear panel and set FREQ STD switch to EXT.
4. Set SENSITIVITY switch to 10V rms position.
5. Connect lower frequency f_2 to INPUT connector.
6. Turn SENSITIVITY switch clockwise until stable count is displayed. Adjust -LEVEL+ control for proper triggering.
7. Set function selector to PERIODS AVERAGED multiplier which gives the desired resolution.
8. Divide display by period multiplier to obtain f_1/f_2. Disregard decimal point and measurement units.

Figure 3-8. Time Interval Measurements



1. Turn counter on with SAMPLE RATE control.
2. Set function switch to 1 PERIODS AVERAGED.
3. Set FREQ-PER/TIME INT switch to TIME INT.
4. Connect start and stop control signals to START and STOP jacks.
5. Trigger stop signal.
6. Reset counter.
7. Trigger start signal.
8. Trigger stop signal.
9. Read time interval from display.

NOTE

In the 1 PERIODS AVERAGED function, decimal point and measurement unit is correct.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. The Electronic Counter measures frequencies between 3 Hz and 12.5 MHz with seven digit display. In addition, time interval, period, and ratio measurements can be made. An internal 1 MHz time base frequency is standard and provides the clock signal for counting. Four line BCD code is supplied with assigned weights of 1, 2, 4, 8 and "1" or high level positive with respect to the "0" or low level. This BCD code is available at the rear panel for use with a digital recorder. The self check operation mode permits counting the internal time base signal to insure that the decade counters, gates, function selector switch, input amplifier, and time base are operating.

4-3. BLANKING

4-4. The blanking feature suppresses the display of insignificant zeros in the display. Blanking can be manually disabled with the rear panel storage switch off. This simultaneously disables the storage of input data. Thus, with no blanking or storage, the digital display will continuously change while the new count is being totalized.

4-5. GATING AND LOGIC

4-6. The counter circuits make extensive use of integrated circuits. As a result, it is necessary to understand basic logic symbols and their application in gating. In the circuit diagrams, AND gate and OR gate symbols are used extensively. The following paragraphs and illustrations introduce logic symbols and their applications.

4-7. Logic Symbols

4-8. The symbol shown in Figure 4-1A is for the basic AND function. The basic AND gate output is high if all inputs are high. The AND gate can have two or more inputs. The symbol in Figure 4-1D is for the basic OR gate. The basic OR gate output is high when one or more of its inputs is high. The OR gate can also have two or more inputs. A small circle at the input line of a logic symbol indicates a low (L) level activates the function. The symbol of Figure 4-1B shows a low input on all lines causes a high (H) output. A small circle at the output line of a logic symbol indicates a low (L) level when activated, as shown in Figure 4-1C. Thus, the small circle indicates inversion. This applies to both types of gates. Figure 4-2

Figure 4-1. Gate Symbols

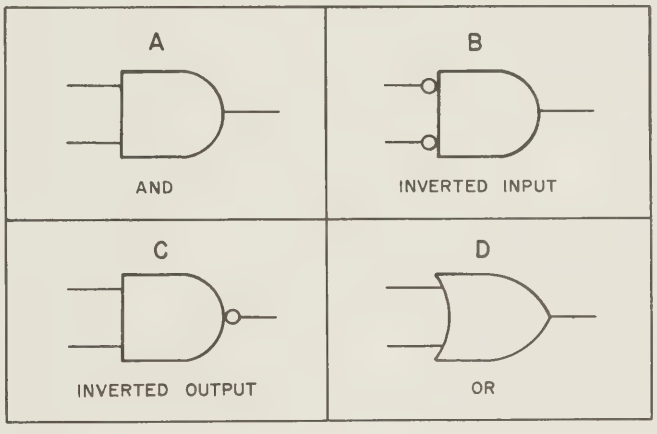
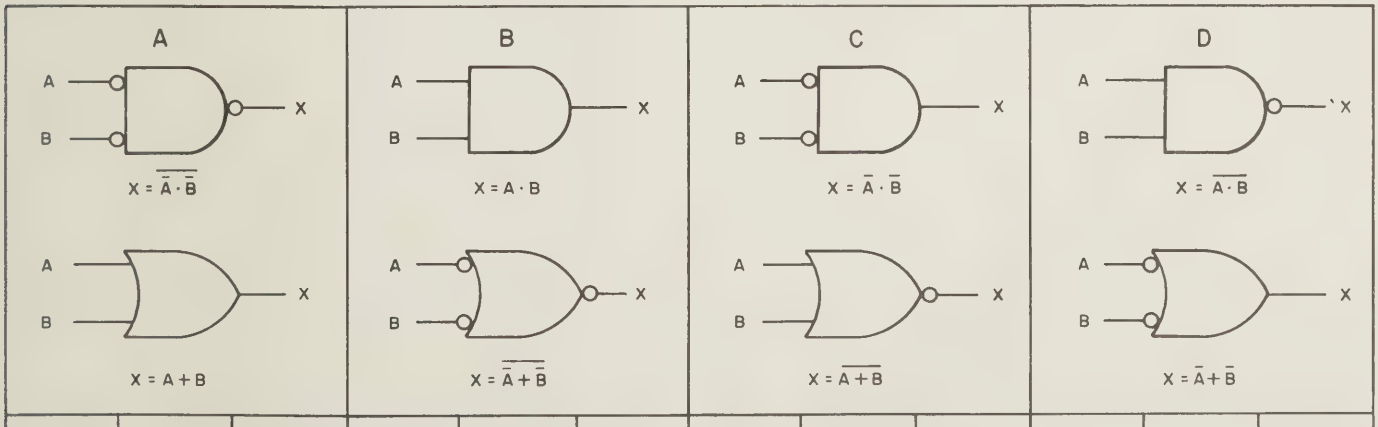


Figure 4-2. Logic Function Comparison



A	B	X	A	B	X	A	B	X	A	B	X
H	H	H	H	H	H	H	H	L	H	H	L
H	L	H	H	L	L	H	L	L	H	L	H
L	H	H	L	H	L	L	H	L	L	H	H
L	L	L	L	L	L	L	L	H	L	L	H

lists examples and truth tables for logic actions. When the output of the OR gate is inverted, it is referred to as a NOR gate. Similarly, an inverted AND gate output gives a NAND gate.

4-9. Two states exist in the binary system, high (H) and low (L). H is more positive than L. In positive logic the one state is more positive than the zero state. In negative logic the one state is less positive than the zero state. In positive or negative logic H always represents the more positive level. In this manual, positive logic is used.

4-10. Multiple Input JK Flip-Flop

4-11. Figure 4-3 illustrates the specific JK flip-flop used for main flip-flop A4IC7. The distinguishing features of this JK flip-flop are the multiple input gates at the J and K inputs.

4-12. JK Master-Slave Flip-Flop

4-13. The JK master-slave flip-flop is a bistable MV. A unique feature is that with a simultaneous high input to J and K, before the clock pulse, Q and $\overline{Q}$ will change states after the clock pulse. Refer to Figure 4-4 and Table 4-1. The JK master-slave flip-flop triggers on the trailing edge of the clock pulse. The preset (P) and clear (C) inputs operate as follows: if a low is applied to the preset input, $\overline{Q}$ will go low. If a low is applied to the clear input, Q will go low. In the JK master-slave flip-flop, either preset or clear can override all other inputs at any time.

Figure 4-3. Multiple Input JK Flip-Flop

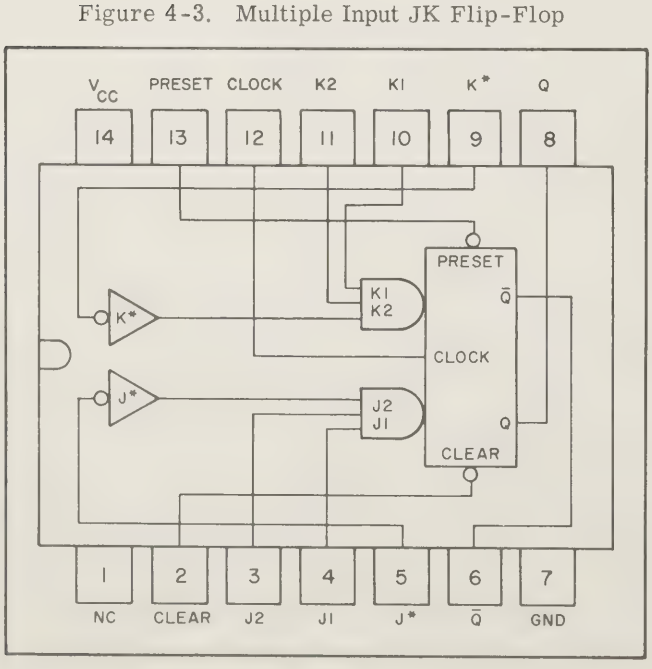


Figure 4-4. JK Flip-Flop

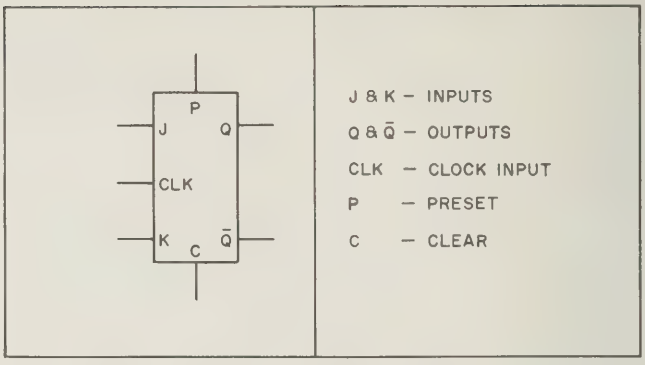


Table 4-1. Truth Table

t_n		$t_n + 1$		t_n = before clock pulse $t_n + 1$ = after clock pulse
J	K	Q	$\overline{Q}$	
0	0	Q_n	$\overline{Q}_n$	If J = 0 and K = 0, then Q and $\overline{Q}$ will not change from what they were before the clock pulse.
1	0	1	0	If J = 1 and K = 0, then Q will be a 1 and $\overline{Q}$ a 0 after clock pulse.
0	1	0	1	If J = 0 and K = 1, then Q will be a 0 and $\overline{Q}$ a 1 after a clock pulse.
1	1	$\overline{Q}_n$	Q_n	If J = 1 and K = 1 before clock, then after clock pulse Q and $\overline{Q}$ will change states.

4-14. INPUT ATTENUATOR ASSEMBLY A1
Schematic Diagram Figure 8-6

4-15. Input Attenuator A1 includes SENSITIVITY switch S1 and associated mounted components in a shielded compartment. The -LEVEL+ control A1R10 is mounted on the rear of the shield. In CHECK, 1 MHz from main board assembly A4 goes through S1 to input amplifier assembly A2. In 10, 1, and .1 positions, resistive dividers with capacitive compensation are switched in to attenuate the input signal. In .01, the input signal is applied straight through to A2.

4-16. INPUT AMPLIFIER ASSEMBLY A2
Schematic Diagram Figure 8-7

4-17. Input Amplifier A2 provides about 33 dB gain, A2 output drives the shaping amplifier in next assembly A4. Source follower Q1, Q2 used field effect transistor Q1 and feedback amplifier Q2 for isolation. Voltage gain of the stage is unity. Diodes CR1 and CR2 are limiters. Q3, Q4 and Q5, Q6 provide two stages of amplification to drive trigger Q7, Q8. This trigger drives pulse amplifier Q9, Q10. The pulse amplifier output then goes to next assembly A4. Q11, with A1R1, adjusts bias level for the trigger circuit.

4-18. 1 MHz OSCILLATOR ASSEMBLY A3

Schematic Diagram Figure 8-8

4-19. A3 1 MHz oscillator contains oscillator Q1, buffer amplifier Q2, and associated components.

4-20. MAIN BOARD ASSEMBLY A4

Schematic Diagram Figure 8-9

4-21. Main board assembly A4 is shown on three pages in the schematic section of this manual. The first page contains the time base gating and decade dividers plus gating. The second page includes gate control, main gate, and sample rate and reset multivibrators. The third page contains display components and BCD information outputs. Additional diagrams at the back of this manual show the signal path through the main board circuits for operation in the following modes: frequency, period, ratio, and time interval. On these functional operation diagrams, input signal is shown with a heavy line while the time base signal is indicated by a dashed line.

4-22. A4 MAIN BOARD

4-23. INPUT CIRCUIT. The Counter INPUT signal, after processing by the input attenuator (A1) and amplifier (A2), is connected to the main board (A4) through A4(3) to shaping amplifier Q4. The Q4 collector output is connected to two inputs, pins 1 and 4 of IC5, the function control selector.

4-24. BUFFER AND SCHMITT TRIGGER. The internal time base signal at A4J2(11) is amplified and isolated by A4Q1 and the output of Q1 is applied to IC6C(1). In the EXT FREQ STD mode the external time base signal is applied through J4 and A4J2(H) to a Schmitt trigger composed of A4Q2, Q3, and Q5. The Schmitt trigger output is applied to IC6C(2).

4-25. SIGNAL-TO-BE COUNTED SELECTOR. The gate formed by IC5A-B-C controls which signal is counted. When IC5A(5) is enabled by a high (FREQUENCY mode) the pulses at IC5A(4) (which are derived from the counter input signal through A2 and A4Q4) are steered through IC5A and B to the main gate for counting. When IC5C(3) is enabled by a high (PERIOD mode) the time base signal at IC5C(2) (from A3 through A4Q1, Q2, Q3, Q5, and IC6C) is steered through IC5C and IC5B to the main gate to be counted.

4-26. MAIN GATE CONTROL SELECTOR. The gate formed by IC5D-E-F selects the signal which will control the Main Gate. When IC5D(13) is enabled by a high (PERIOD mode), the pulses at IC5D(1), which are derived from the counter input signal, are steered through IC5D and E to decade divider IC3A. In "1 PERIOD" mode the output of IC5E(8) are directly through IC6D and B to the main gate control flip-flop, IC7(12), as the CLOCK signal. When IC5F(9) is enabled by a high (FREQUENCY mode) the 10 kHz (or external frequency standard divided by 10) from IC4A(13) is steered through IC5F and E to decade divider IC3A(2) input.

4-27. DECADE DIVIDERS (IC3, IC2, and IC1). The output of main gate control selector, IC5E(8) is applied to the input, IC3A(2), of the decade divider string (IC3A, IC3B, IC2A, IC2B, and IC1A). Each IC section of the decade divider string divides its pin 2 or 10 input signal by 10, and supplies the 10 output at pin 4 or 12 to the next divider. A gated output is at pin 13 or 5. The gate control (enabled by a ground) is applied to pin 14 or 6. The function-range switch S2 selects which decade divider gated output is enabled and applied through IC6B to the main gate flip-flop, IC7(12).

4-28. SAMPLE RATE Flip-Flop (IC9A). This is a master-slave flip-flop. With the J input connected to +5.1 V (high) and the K input connected to ground (low) if a + pulse is applied to the CLK (clock) input, the flip-flop will set (Q=1). A low applied to the CLR (clear) will make Q=0 regardless of the J and K input levels.

4-29. RESET Flip-Flop (IC9B). The reset flip-flop is the same type as the sample rate flip-flop.

4-30. COUNTER MAIN GATE LOGIC. When the main gate flip-flop (IC7) is cleared (reset) IC7$\overline{Q}$ is high and Q is low. The high from IC7$\overline{Q}$ closes the main gate (Q14-Q13), Q14 is on. The low from IC7Q output is connected to IC7$\overline{J}$ and the low is inverted to high. Both IC7J1 and 2 are high because IC9A and IC9B are cleared, making both $\overline{Q}$ outputs high. With IC7J high and IC7K low (the Q output low is connected to K1 input which makes the K low), a positive transition at the CLK input will set the main gate flip-flop. Then IC7Q will be high and $\overline{Q}$ will be low. With $\overline{Q}$ low Q13 is switch off (the main gate is closed).

4-31. A pulse signal to Q13 base can switch Q13 off producing a positive pulse at the Q14-Q13 collectors. This is the pulse to be counted. When the main gate flip-flop is set, as described in the preceding paragraph, IC7Q is high and $\overline{Q}$ is low. The IC7 output is connected to IC7$\overline{J}$ and K1. This makes IC7J low and K input high, which allows the main gate flip-flop to be reset by the next CLK pulse, closing the main gate.

4-32. The main gate flip-flop Q output is connected to the CLK input of the sample rate flip-flop, IC9A. The sample rate flip-flop will set when the CLK input goes from high to low. When set, the sample rate flip-flop Q output goes high and $\overline{Q}$ goes low. The sample rate flip-flop $\overline{Q}$ output is connected to the J1 input of the main gate. So with the sample rate flip-flop set there is a low at both J gate and K gate inputs of the main gate flip-flop. This disables the main gate flip-flop while the sample rate flip-flop is set.

4-33. The sample rate flip-flop Q output high goes through R29, R28, and the SAMPLE RATE control (R1) to C7 and the base of Q9. Capacitor C7 starts charging at a rate determined by R29, R28, and the setting of the SAMPLE RATE control. At some time during the charging of C7, Q9 and Q10 switch on which switches IC6A on and IC6A(6) goes low at the CLK input of IC9B, the reset flip-flop. This negative transition clocks the reset flip-flop and since J is tied high and K is tied low the flip-flop is set; Q goes high and $\overline{Q}$ goes low. The reset flip-flop $\overline{Q}$ output is connected to the J2 input of the main gate flip-flop. The reset flip-flop Q output is also connected to the CLR (clear) input of

the sample rate flip-flop which is cleared by the low. The sample rate flip-flop Q output goes low forward biasing CR15 and allowing C7 to discharge through R29. When the reset flip-flop is set, the high at the Q output charges C8 through R30 and eventually switches Q8 on which applies a high to IC8C(5). The IC8(5) high is inverted at IC8C(6) and this low is applied to the reset flip-flop CLR input which clears the reset flip-flop. With the reset flip-flop cleared its $\overline{Q}$ output goes high and this high is applied to the J2 input of the main gate flip-flop. The J1 input of the main gate flip-flop is high since the sample rate flip-flop is cleared with its $\overline{Q}$ output high. With the main gate flip-flop J input high and K input low the main gate flip-flop is ready to be clocked by the next pulse from IC6B(8).

4-34. ONE-SHOT AND DRIVER (A4Q12 and Q4Q11). If less than a full pulse is received by Q12 from the main gate, Q14-Q13, the one-shot will either produce a standard width and amplitude pulse to Q11 or no pulse at all. This eliminates triggering on less than a full pulse.

4-35. The main gate signal from R42 goes to decade counter IC35 pin 5. BCD information from the first decade goes to buffer storage unit IC34 and also to next decade IC32 pin 9. The buffer storage unit BCD information is taken off for a digital recorder from printed circuit connections on main board assembly jack A4J1. This is 1248 BCD code with "1" state positive. BCD information from the buffer storage unit goes to a decoder driver which has a 1248 "1" state negative output. The decoder unit then drives digital display tube DS7. The process is repeated in the other stages of counting, storage, and display.

4-36. POSITIVE RESET SIGNAL. When the reset flip-flop is set, the $\overline{Q}$ output is low and IC8E inverts the low for the positive reset signal to IC3A(16) and IC24(14). The positive reset signal resets the decade dividers IC1, IC2, IC3, and the decade counters IC28 to IC30.

4-37. PRINT COMMAND. The print command from Q15 collector is high during display time.

4-38. GATE LIGHT AMPLIFIER. The gate light amplifier, Q16, is switched by the main gate flip-flop $\overline{Q}$ output. The gate light is on when Q16 is off. The R45 and C12 circuit stretches short pulses to insure flashing the gate light for short gate times.

4-39. TIME INTERVAL START-STOP. In the START mode the main gate is held open continuously by the low applied to the PRE (preset) input of IC7. While the main gate is open the counter input signal is being counted as pulses and displayed. When the function switch is moved to STOP the main gate is closed and the total of the signals counted while the gate was open is displayed. Both START and STOP functions can be remotely controlled through back panel connectors.

4-40. BUFFER STORAGE TRANSFER SIGNAL. At the end of the gate time the IC9AQ output goes from high to low and this signal is coupled through R23 and C6 to the base of Q7 which is momentarily switched off and the Q7 collector (and IC8D(9)) goes high. The output of IC8D goes low, which is the transfer signal to the buffer storage units. If the STORAGE switch is OFF the output of IC8D is continuously low which is the buffer storage units.

4-41. DECADE DIVIDERS. Decade dividers IC1 through IC8 are 1248 code dividers which divide by 10. The input is at pin 3 and the output is at pin 5. IC1 through 5 have gated outputs from pin 6 controlled by applying a low to pin 7. IC6 has pin 7 permanently forced low; thus, the output is from pin 6 at all times. On IC8, pin 7 is also forced low. The gated output from pin 6 then supplies 1 MHz as a standard signal to jack J4. This is also used as the self-check signal to A1R9.

4-42. DECADE COUNTERS. Decade counter IC35 is a high-speed, non-blanking decade. Input is on pin 5 and the output is from pin 1. It provides a negative 1248 BCD code to buffer storage unit IC34. Decade counters IC17, IC20, IC29, and IC32 are low frequency blanking type decades. Blanking occurs when the storage switch is on and a low is applied to pin 10 of IC17, IC20, IC23, and IC26. IC23 and IC26 may be overridden by applying a high to pin 10. This is controlled by function switch S2E. The 1248 BCD code drives the buffer storage units.

4-43. BUFFER STORAGE UNITS. These units have 4 inputs and 8 outputs. Four outputs are in phase with the input while the other 4 are not. When a low transfer pulse is applied to pin 5, the outputs assume the state of the input. When the low is removed, the outputs remain in their last state until a neutral transfer pulse is applied.

4-44. DECODER DRIVER UNITS. Decoder drivers are BCD-to-decimal decoders with 4 inputs and 10 outputs. A low from the decoder driver to a number in the digital display tube will light that number.

4-45. DECIMAL POINT AND MEASUREMENT UNITS ASSEMBLY A5

Schematic Diagram Figure 8-8

4-46. Neon lamps DS1 through DS3 are decimal point lights. Neon lamps DS4 through DS7 are the measurement unit lights. All are controlled by function switch S2 on the front panel.

4-47. POWER SUPPLY ASSEMBLY A6

Schematic Diagram Figure 8-10

4-48. GENERAL. Four regulated voltage sources of +175, +5, -5.8, and +5.1 volts are on power supply assembly A6. These are the operating voltages for the instrument. In the following discussion, complete reference designations are used to identify components. This is to prevent confusion between identifying components on the chassis and components on power supply assembly A6.

4-49. PRIMARY POWER. Either 115 Vac or 230 Vac is connected through fuse F1 and power switch S1. Slide switch S4 on the rear panel connects T1 primary

windings in parallel for 115 Vac operation or in series for 230 Vac operation.

4-50. +175 VOLT SUPPLY. The +175 volt supply includes full wave rectifier diodes A6CR1 through A6CR4. Series regulator A6Q1 is controlled by variations of the output voltage compared to the zener-controlled A6Q1 base voltage. A6Q4 limits the output current.

4-51. +5/-5.8 VOLT SUPPLY. This supply consists of a full wave rectifier filtered by A6C3. A regulated 12 volts is set by A6CR16, A6CR15, and A6Q2; a center ground is set by A6Q7 and A6R9. A6Q3 regulates the total voltage by controlling the current.

4-52. +5.1 VOLT SUPPLY. This supply consists of full wave rectifier diodes A6CR9 through A6CR12 with filtering by A6C2, A6C5. Series regulator Q1 is driven by A6Q5. Voltage level is controlled by reference amplifier A6Q6 with bias set by A6R10. Thermistor A6RT1 compensates for changes in current. Further filtering is by A6C6 and A6C7.

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides maintenance and service information for the Model 5216A. Included are: table of recommended test equipment; in-cabinet performance check; troubleshooting procedures; plus repair and adjustment procedures.

5-3. ASSEMBLY DESIGNATIONS

5-4. Table 5-1 lists the designation, name, and part number of assemblies used in the instrument.

5-5. TEST EQUIPMENT

5-6. Recommended test equipment for troubleshooting and performance checking is listed in Table 5-2.

Table 5-1. Assembly Identification

Assy	Name	HP Part No.
A1	Input Attenuator	05216-6005
A2	Input Amplifier	05216-6003
A3	1 MHz Oscillator	05216-6010
A4	Main Board	05216-6013
A5	Decimal Point and Measurement Unit	05216-6004
A6	Power Supply	05216-6012
W1	Cable, Gate Light	05216-6014

5-7. INSTRUMENT COVER REMOVAL

5-8. To remove top cover, take out two screws securing the rear of top cover to main chassis. Slide cover to rear about 1/4 inch, then lift rear of cover. To remove bottom cover, first set tilt bail at right angle with bottom cover. Then take out two screws securing the rear of cover to the main chassis. Remove rear plastic foot according to directions on foot. Slide cover to rear and remove. To install cover, reverse procedure.

WARNING

115/230V ac and dc supply wires are exposed when either cover is removed. Exercise extreme caution during troubleshooting, adjustment, or repair. Disconnect ac power from instrument before removing or replacing covers or assemblies.

5-9. IN-CABINET PERFORMANCE CHECK

5-10. The in-cabinet performance check outlined in Table 5-3 lists checks to verify specifications. The Performance Check Test Record page can be filled out during the checks to provide a permanent record of performance of each instrument. The in-cabinet performance checks can be used:

a. As part of an incoming inspection check of instrument specifications;

b. Periodically, for instrument used in systems where maximum reliability is of utmost importance;

Table 5-2. Recommended Test Equipment

INSTRUMENT	CHARACTERISTICS	RECOMMENDED TYPE
Low Frequency Oscillator	Range: 1 Hz to 100 kHz Output: 10 mV to 1 V rms	HP Model 202C
Signal Generator	Range: 50 kHz to 12.5 MHz Output: 10 mV to 3 V rms	HP Model 606B
Oscilloscope	Bandwidth: dc to 12.5 MHz Sensitivity: 10 mV to 10 V	HP Model 175A with 1755A and 1780A plug-ins
DC Voltmeter	Range: 0 to 155 V dc Accuracy: ±1% of full scale Input impedance: 100 megohms	HP Model 412A
Frequency Standard	Frequency: 1 MHz Level: 1 V rms	HP Model 107AR
Preset Counter	Output: positive or negative pulses (use inverter with positive pulses), variable time between pulses	HP Model 5214L
Power Supply	Range: +5 V, -15 V at 5 ma	HP Model 721A

c. As part of a troubleshooting procedure to locate troublesome circuits, and

d. After any repairs or adjustments, before returning instrument to regular service.

5-11. TROUBLESHOOTING

5-12. General

5-13. Trouble isolation can best be accomplished by first obtaining all possible information from the controls, indicators, and connectors; then logically applying this information to locate the defective circuit or component. Operating procedures in Section III and circuit diagrams in Section VIII can be used to help understand operation. Table 5-1 lists the printed circuit assemblies in the instrument. Figure 5-2 shows the location of assemblies and chassis-mounted components in the instrument. Refer to component location figures, voltages, and waveforms with the schematic diagrams in Section VIII. The performance check (Table 5-3) and troubleshooting tables 5-4 and 5-5 are also useful for locating trouble.

5-14. Removal of Main Board Assembly A4

5-15. To remove main board assembly A4:

a. Remove the top and both side covers (see Paragraph 5-7).

b. Remove front panel window by sliding it out either side.

c. Reach inside the side castings and gently lift sides of main board. Pull the board forward with the fingers.

d. After board is started, remove connector XA4.

e. Push or pull board out of counter being careful to keep board moving in a straight line.

f. To replace board, reverse the above procedure.

Make sure connector XA4 is reconnected and none of the wires are pinched by the board.

Table 5-3. In-Cabinet Performance Check

FREQUENCY MEASUREMENTS

1. RANGE: 3 Hz to 12.5 MHz

   a. Set Counter controls as follows:

SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function Switch	FREQUENCY, 1 sec
SAMPLE RATE	cw out of POWER OFF

   b. Connect Low Frequency Oscillator to Counter and Oscilloscope with BNC "T" connector (Oscilloscope is used to monitor input signal level).

   c. Vary frequency from 3 Hz to 50 kHz, keeping signal level constant at 0.01 V rms (0.028 V peak-to-peak).

   d. Substitute Signal Generator for Low Frequency Oscillator and set Counter function switch to .1 sec.

   e. Vary frequency from 50 kHz to 12.5 MHz at 0.01 V rms (0.028 V peak-to-peak). Record results on test card.

2. SENSITIVITY: 0.01 V rms sine wave, 3 Hz to 12.5 MHz. Sensitivity checked by Procedure 1, Range Check.

3. GATE TIMES: 10, 1, .1, .01 seconds

   a. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function Switch	FREQUENCY .01 sec

   b. Connect Signal Generator to INPUT jack. Set Signal Generator output to 10 MHz at 0.01 V rms.

   c. Rotate function switch to each gate time and observe counter display for each setting. Record.

Table 5-3. In-Cabinet Performance Check Cont'd.

FREQUENCY MEASUREMENTS Cont'd.

4. READOUT: 7 significant digits with decimal point positioning and measurement unit display (kHz or MHz).

   CHECK: counts 1 MHz for the GATE TIME selected by the function switch.

   a. Use Self Check procedure, Figure 3-3, Page 3-4.

   b. Record results on test card.

TIME INTERVAL MEASUREMENTS

RANGE: 10 μs to 10 s

a. Connect test setup shown in Figure 5-1 and set 5216A controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	not CHECK
- LEVEL + ...	adjust for stable count
Function switch	1 PERIOD AVERAGE
FREQ-PER TIME INT . . .	TIME INT

b. Set 5214L controls as follows:

SENSITIVITY	CHECK
FUNCTION	TIME
MULTIPLIER	X1
SAMPLE RATE	cw out of POWER OFF
"N" switches	00100

c. Reset both counters.

d. "N" switches may be set at any number desired.

e. Display should be the same on both counters. Record results on test card.

Figure 5-1. Test Setup for Time Interval Checks

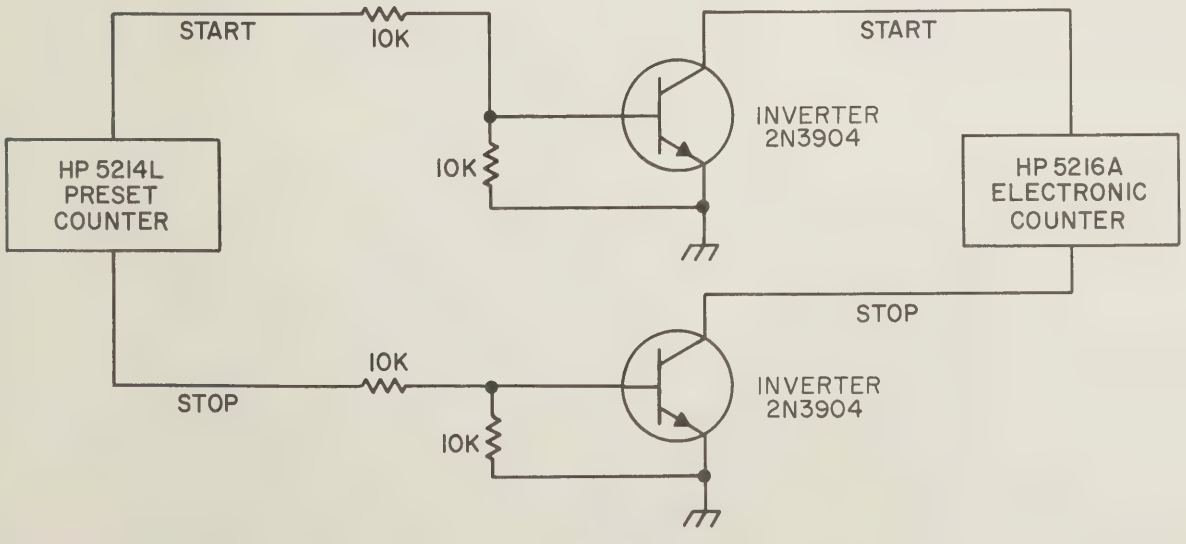


Table 5-3. In-Cabinet Performance Check Cont'd.

PERIOD MEASUREMENTS

1. FREQUENCY RANGE SINGLE PERIOD: 3 Hz to 1 MHz

   a. Set Counter controls as follows:

SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function switch	1 PERIOD AVERAGE
SAMPLE RATE	cw out of POWER OFF

   b. Connect Signal Generator to Counter.

   c. Set Signal Generator output to 1 MHz at 0.01 V rms.

   d. Counter should read .001 ms with decimal point correctly positioned and measurement unit displayed. Record results on test card.

2. FREQUENCY RANGE MULTIPLE PERIOD: 3 Hz to 2 MHz

   a. Set Counter controls as follows:

SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function switch	10 PERIOD AVERAGE
SAMPLE RATE	cw out of POWER OFF

   b. Connect Signal Generator to Counter.

   c. Set Signal Generator output to 2 MHz at 0.01 V rms.

   d. Check Counter at each PERIOD AVERAGE setting, 10 through 100K. Record results on test card.

3. INPUT SENSITIVITY: 100 mV from 3 Hz to 1 kHz, 10 mV from 1 kHz to 2 MHz. Sensitivity checked in Range checks, procedures 1 and 2.

RATIO MEASUREMENTS

1. F1 FREQUENCY RANGE: 1 kHz to 10 MHz.

   a. Set Counter controls as follows:

SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function switch	100 PERIOD AVERAGE
SAMPLE RATE	cw out of POWER OFF
FREQ STD	EXT
STORAGE	ON

   b. Connect f_2 100 kHz frequency standard to INPUT jack.

   c. Connect Signal Generator (f_1) to FREQ STD jack on rear panel. Set output to 2 MHz at 1V rms.

   d. Make checks indicated in the following table. Record results on test card.

f_1	f_2	X100 Periods Ratio Display
2.0 MHz	100 kHz	02000
1.5 MHz	100 kHz	01500
1.0 MHz	100 kHz	01000
500 kHz	100 kHz	00500
100 kHz	100 kHz	00100
50 kHz	100 kHz	00050
10 kHz	100 kHz	00010
1 kHz	100 kHz	00001

Table 5-3. In-Cabinet Performance Check Cont'd.

RATIO MEASUREMENTS Cont'd.

2. F2 FREQUENCY RANGE: 3 Hz to 1 MHz, Single Period
   3 Hz to 2 MHz, Multiple Period

   a. Set Counter controls as follows:

SENSITIVITY	.01 V
- LEVEL + ...	adjust for stable count
Function switch	10K PERIODS AVERAGED
SAMPLE RATE	cw out of POWER OFF
FREQ STD	EXT
STORAGE	ON

   b. Connect f_1 100 kHz frequency standard to FREQ STD jack on rear panel.

   c. Connect Signal Generator (f_2) to INPUT jack. Set output to 2 MHz at .01 V rms.

   d. Make checks shown in the following table. Record results on test card.

f_1	f_2	Periods Averaged	f_1/f_2 Display
100 kHz	2 MHz	10K	00500
100 kHz	1.5 MHz	10K	00660
100 kHz	1 MHz	10K	01000
100 kHz	500 kHz	10K	02000
100 kHz	100 kHz	10K	10000
100 kHz	50 kHz	10K	20000
100 kHz	10 kHz	10K	100000
100 kHz	1 kHz	1K	100000
100 kHz	500 Hz	1K	200000
100 kHz	100 Hz	100	100000
100 kHz	50 Hz	100	200000
100 kHz	10 Hz	10	100000
100 kHz	3 Hz	1	33333

3. SENSITIVITY: f1: 1 kHz to 2 MHz, 1 V rms minimum
   f_2: 3 Hz to 1 kHz, 100 mV rms; 1 kHz to 2 MHz, 10 mV rms
   Sensitivity checked in procedures 1 and 2, Range checks.

TIME BASE

1. TIME BASE FREQUENCY: 1 MHz

   STABILITY: Aging Rate: ±1 part in 10^6/month
   Temperature: ±3 parts in 10^5 (+0° to +50°C)
   ±5 parts in 10^6 (+10° to +40°C)
   Line Voltage: ±1 part in 10^6 for ±10% line voltage change

   a. Connect 1 MHz frequency standard to Oscilloscope trigger input.

   b. Connect Oscilloscope vertical input to Counter FREQ STD jack.

   c. Set Oscilloscope for external triggering and .1 μs/cm sweep.

   d. Horizontal drift of Oscilloscope pattern in cm/sec is difference between standard frequency and Counter time base frequency in parts in 10^6. Record.

   e. Record frequency difference. For long term stability, this test should be made daily for one month.

   f. Vary line voltage ±10% and record frequency difference.

   g. Vary operating temperature from +10°C to +50°C and record frequency difference.

Table 5-3. In-Cabinet Performance Check Cont'd.

TIME BASE Cont'd.

2. OUTPUT FREQUENCY: 1 MHz at 3 V peak-to-peak

   a. Connect output of Counter FREQ STD jack to Oscilloscope vertical input.

   b. Oscilloscope should display a 1 MHz nonsinusoidal wave of 3 V peak-to-peak. Record frequency and amplitude on test card.

3. EXTERNAL INPUT: 1 MHz sine wave, 1 V rms

   a. Connect 1 MHz standard frequency to Counter FREQ STD jack.

   b. Set INT/EXT switch to EXT.

   c. Perform self check procedure, Figure 3-3.

   d. Record results on test card.

DISPLAY STORAGE

a. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	CHECK
Function switch	.01 sec
STORAGE	OFF

b. Counter should display 001.0000 MHz. The change in count should be visible in each digital display tube.

c. Set STORAGE switch to STORAGE position. The counter should count, display, and hold 1.0000 MHz and provide a continuous display of the most recent count. Record results on test card.

SAMPLE RATE

Variable from 50 ms to 5 sec.

a. Set Counter controls as follows:

SAMPLE RATE	POWER OFF
Function switch	.01 sec
SENSITIVITY	CHECK

b. Turn counter SAMPLE RATE control slightly cw out of POWER OFF, and note that counter turns on.

c. With SAMPLE RATE control in maximum position (ccw), observe gate light duration between gate closing and the following gate opening; it should be 50 ms.

d. Increase SAMPLE RATE control clockwise to minimum sample rate. Observe gate light duration between gate closing and the following gate opening; it should be more than 5 seconds.

e. Set SAMPLE RATE control to HOLD position. The last counter reading should remain displayed indefinitely. Record results on test card.

NOTE: This is a visual check and not an accurate check of the sample rate.

Table 5-3. In-Cabinet Performance Check Cont'd.

GATE INDICATOR

Front panel indication of main gate "open" state (GATE light on).

a. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	CHECK
Function switch	1 s

b. Observe counter gate lamp, lamp should turn on and off at one second intervals. Record results on test card.

RESET CAPABILITY

A momentary control on the front panel that returns both the displayed and internal count to zero.

a. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	CHECK
Function switch	1 s

b. Push front panel RESET pushbutton. Counter should reset and then start a new count.

c. Rotate function switch. As function is changed the counter should reset and start another count.

d. A remote contact closure or saturated NPN transistor to ground connected to RESET jack (rear panel) should reset counter and start a new count. Allow 30 ms between external reset pulse and start pulse.

DIGITAL OUTPUT

1. OUTPUT 4 LINE 1248 BCD CODE: Impedance 7500 ohm each line
"1" state level (H) +5 V
"0" state level (L) 0 V

a. Impedance determined by BCD output circuit on main board assembly A4.

b. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
Function switch	.1 sec
SENSITIVITY	.1 V

c. Connect signal source to counter INPUT jack.

d. Connect Oscilloscope to connections indicated on A4J1 to verify "0" state and "1" state levels. Oscilloscope will display step from "0" state (0 volts) to "1" state (+5 volts). Check all recorder outputs for "0" state and "1" state. Record on test card.

Table 5-3. In-Cabinet Performance Check Cont'd.

DIGITAL OUTPUT Cont'd.

1. OUTPUT 4 LINE 1248 BCD CODE

A4J1 Pins		A4J1 Pins	
17, 16, 15, 18	First Decoder A4IC33. Set Low Frequency Oscillator to 10 Hz at .1 V rms.	L, 9, 10, K	Fifth Decoder A4IC21. Set Signal Generator to 100 kHz at .1 V rms.
6, 7, 8, 5	Second Decoder A4IC30. Set Low Frequency Oscillator to 100 Hz at .1 V rms.	11, 13, 14, 12	Sixth Decoder A4IC18. Set Signal Generator to 1 MHz at .1 V rms.
F, H, J, E	Third Decoder A4IC27. Set Low Frequency Oscillator to 1 kHz at .1 V rms.	S, V, U, T	Seventh Decoder A4IC15. Set Signal Generator to 10 MHz at .1 V rms.
R, N, M, P	Fourth Decoder A4IC24. Set Low Frequency Oscillator to 10 kHz at .1 V rms.		

2. REFERENCE LEVELS: 0 volts and +5 volts, low impedance

   a. Set SAMPLE RATE control slightly clockwise out of POWER OFF.

   b. Connect DC Voltmeter to DIGITAL RECORDER jack A4J1 pins 3, C to check +5 V positive reference and A4J1 pins 1, A for 0 V reference. Record results on test card.

3. PRINT COMMAND: Positive step from 0 V to +5 V, dc coupled.

   a. Connect Oscilloscope to DIGITAL RECORDER jack A4J1 pin 4.

   b. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	CHECK
Function switch	.01 sec

   c. Oscilloscope should display the print command step (+5 V for each counting cycle). Record results on test card.

4. HOLD-OFF REQUIREMENTS: -10 V to -15 V

   a. Set Counter controls as follows:

SAMPLE RATE	cw out of POWER OFF
SENSITIVITY	CHECK
Function switch	10 sec
STORAGE	OFF

   b. With DC Power Supply, apply inhibit voltage, -10 volts, to DIGITAL RECORDER jack A4J1 pin 2. The counter should stop until the inhibit voltage is removed. Record results on test card.

   c. Repeat step b using -15 volt inhibit voltage. Record on test card. This check can be made using any inhibit voltage from -10 to -15 volts.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5216A
Electronic Counter
Serial No. ___ - _____

Tests Performed by _____
Date _____

DESCRIPTION	CHECK
FREQUENCY MEASUREMENT	
1. Range: 3 Hz to 12.5 MHz	☐ 3 Hz to 12.5 MHz
2. Sensitivity: .01 V rms sine wave, 3 Hz to 12.5 MHz	☐ .01 V
3. Gate Times: 10, 1, .1, .01 seconds	☐ 10 sec ☐ 1 sec ☐ .1 sec ☐ .01 sec
4. Readout: 7 significant digits with decimal point and measurement unit display	☐ 7 digits
TIME INTERVAL MEASUREMENT	
1. Range: 10 μs to 10 s	☐ 10 μs to 10 s
PERIOD MEASUREMENT	
1. Range Single Period: 3 Hz to 1 MHz	☐ 3 Hz to 1 MHz
2. Range Multiple Period: 3 Hz to 2 MHz	☐ 3 Hz to 2 MHz
3. Sensitivity: .1 V, 3 Hz to 1 kHz; .01 V, 1 kHz to 2 MHz	☐ .1 V ☐ .01 V
RATIO MEASUREMENT	
1. f_1 Frequency Range: 1 kHz to 2 MHz	Ratio f_1/f_2 ☐ 02000 ☐ 01500 ☐ 01000 ☐ 00500 ☐ 00100 ☐ 00050 ☐ 00010 ☐ 00001
2. f_2 Frequency Range: 3 Hz to 1 MHz Single Period 3 Hz to 2 MHz Multiple Period	☐ 00500 ☐ 00660 ☐ 01000 ☐ 02000 ☐ 10000 ☐ 20000 ☐ 10000 ☐ 100000 ☐ 200000 ☐ 100000 ☐ 200000 ☐ 100000 ☐ 33333

PERFORMANCE CHECK TEST CARD

DESCRIPTION	CHECK
RATIO MEASUREMENT Cont'd.	
3. Sensitivity: f_1 1 V rms min. 1 kHz to 2 MHz f_2 .1 V rms, 3 Hz to 1 kHz .01 V rms, 1 kHz to 2 MHz	☐ f_1 ☐ f_2
TIME BASE FREQUENCY: 1 MHz	
1. Stability: Aging Rate: ± 1 part in 10^6/month	☐ less than ± 1 part in 10^6/month
Temperature: ± 3 parts in 10^5 (0°C to +50°C)	☐ ± 3 parts in 10^5
± 5 parts in 10^6 (+10°C to +40°C)	☐ ± 5 parts in 10^6
Line Voltage: ± 1 part in 10^6 for ± 10% change	☐ less than ± 1 part in 10^6
2. Output Frequency: 1 MHz, 3 V peak-to-peak	☐ 1 MHz, 3 V peak-to-peak
3. External Input: 1 MHz sine wave, 1 V rms	☐ 1 MHz
SAMPLE RATE	
Variable from 50 ms to 5 seconds	☐ less than 50 ms to greater than 5 seconds
DISPLAY STORAGE	☐ count stored
GATE INDICATOR	
Front panel indication of main gate "open" state.	☐ gate light flashes
RESET CAPABILITY	
Manual Reset switch	☐ counter resets
Function switch	☐ counter resets
Remote Reset	☐ counter resets
DIGITAL OUTPUT	
1. Output 4 line 1248 BCD Code: "1" state level +5V "0" state level 0V	☐ +5 V ☐ 0 V
2. Reference Levels: 0 volts and +5 volts low impedance	☐ +5 V A4J1 (3, C) ☐ 0 V A4J1 (1, A)
3. Print Command: Positive step from 0 V to +5 V dc coupled.	☐ +5 volts A4J1 (4)
4. Hold-off Requirements: -10 V to -15 V	☐ -10 V A4J1 (2) ☐ -15 V A4J1 (2)

Figure 5-2. Bottom and Sides Internal Views

Table 5-4. Front Panel Troubleshooting Check

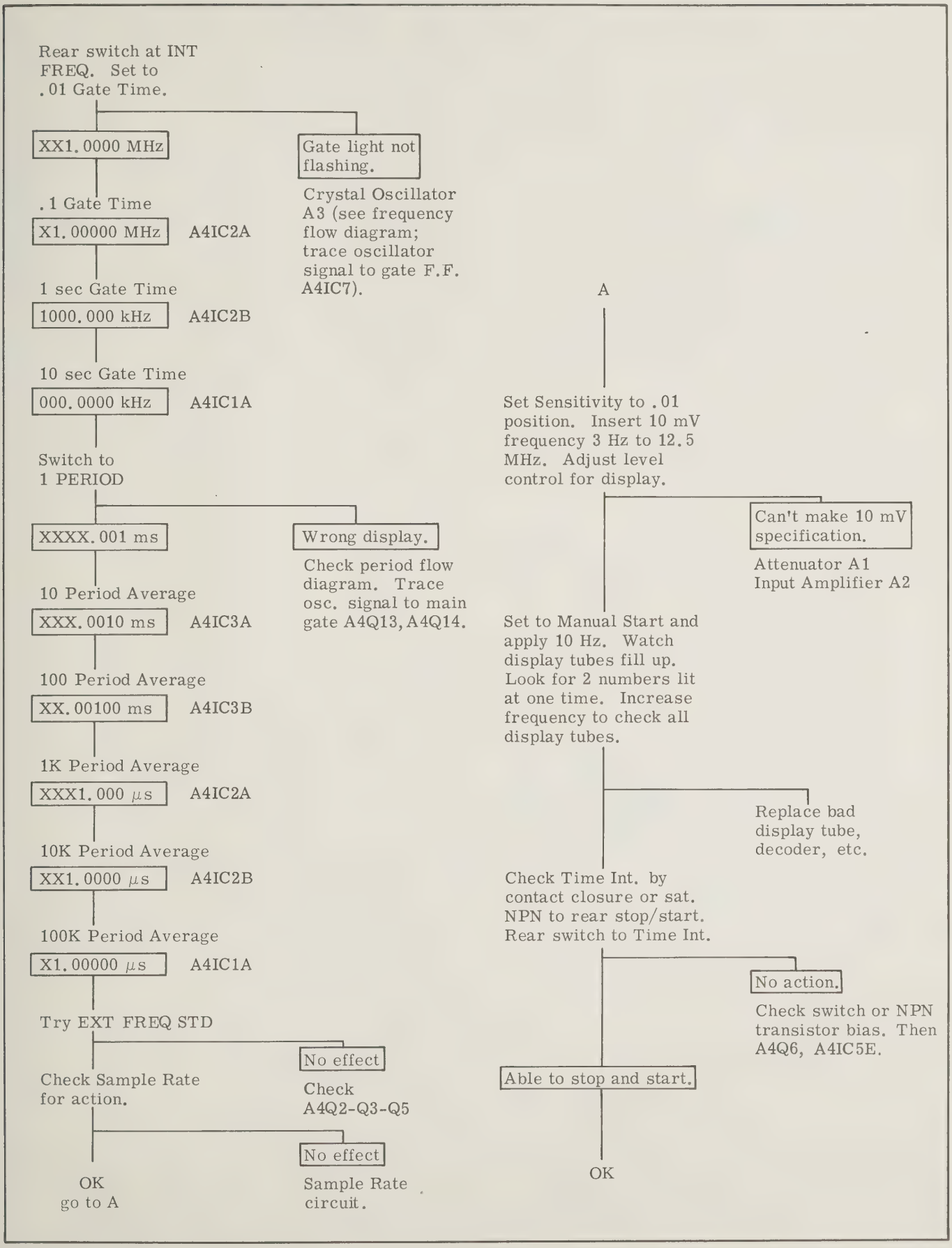
Set Counter controls as follows:

SENSITIVITY	.01
function	MANUAL START
SAMPLE RATE	cw out of POWER OFF
STORAGE	ON
FREQ STD	INT
FREQ-PER/TIME INT . .	FREQ-PER
INPUT	no input signal used

Reset Counter and begin check.

- Gate light on and at least one digit displayed.
  - Storage switch off. Reset counter.
  - Display
  - 0000000 — If other than zeros appear check associated decade, buffer, decoder and display tube (be sure A4Q8, A4IC8C reset is working).
  - Storage switch on. Reset counter.
  - X = blank
  - XX00000 — If all zeros, check storage switch or transfer one-shot multivibrator A4IC8D and IC9A.
  - Sensitivity switch to check. Reset counter.
    - Count totalized to fill display.
      - Front panel switch at stop (gate closed).
        - Gate light off. Display on tubes.
        - Gate light on.
          - A4CR13, A4CR18
          - A4CR17
    - No count or partial fill up.
      - Attenuator A1
      - Input Amplifier A2
      - Crystal Oscillator A3
      - A4Q4
      - A4IC5
      - A4Q12
      - A4Q11
      - High speed decade down to where count stops.
- Gate light off but at least one digit displayed.
  - IC7 Main Gate F. F.
    - $\bar{Q}$ = 0 V
      - A4Q16
      - DS1
    - $\bar{Q}$ = .5 V
      - Check inputs to IC7.
- No gate light no display.
  - Fuse - check
  - Power Supply:
    - +155 V
    - +5.1 V
    - +5 V
    - -5.8 V

Table 5-4. Front Panel Troubleshooting Check Cont'd.



5-16. Substitution

5-17. Replacing the assembly suspected of trouble with a spare assembly known to be operating can greatly simplify troubleshooting. When a defective assembly is found, the trouble can then be traced to individual components. The defective assembly can be shipped to the nearest Hewlett-Packard Sales and Service office for repair.

5-18. Printed Circuit Component Replacement

5-19. Component lead holes in the circuit boards have plated walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to this plating, apply heat sparingly and work carefully. The following replacement procedure is recommended:

a. Remove defective component by first heating terminals on either side of board until solder melts. Then gently remove part with long nose pliers. Use a clean, 37 watt soldering iron.

b. Melt solder in component lead holes. Clean holes with toothpick or wooden splinter. Do not use a metal tool for cleaning holes.

c. Shape component leads and insert into cleaned holes. Solder into place using heat and solder sparingly; a heat sink such as long nose pliers or a commercial heat sink should be used when replacing transistors or diodes.

d. Through-hole plating breaks are indicated by separation of the round conductor pad from either side of the board. To repair breaks, press conductor pad against board and solder replacement component lead to conductor pads on both sides of board.

5-20. ADJUSTMENTS

5-21. Adjustment procedures for the 10 MHz Oscillator and the Power Supply are given in Paragraphs 5-22 and 5-24. The listings are in the preferred order of adjustment.

5-22. Power Supply Assembly A6

5-23. To adjust the +5.1V supply:

a. Connect DC Voltmeter to A6(2).

b. Turn on Counter.

c. Adjust A6R7 for +5.1V ±.02V.

5-24. 1 MHz Oscillator Assembly A3

5-25. To check Oscillator frequency, use test setup in Figure 5-3.

NOTE

For best long term stability, the Counter should warm up for 24 hours before checking frequency.

a. Connect 1 MHz standard to EXT SYNC input on Oscilloscope.

b. Connect output from 5216A FREQ STD jack to Oscilloscope Vertical Input.

c. Adjust A3C5 (Coarse) and A3C6 (Fine) until sine wave display is stationary.

Figure 5-3. Oscillator Frequency Test Setup

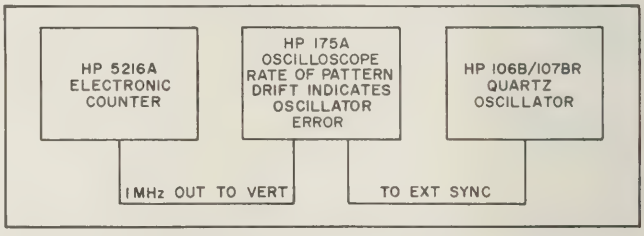


Table 5-5. Function Switch Connections to Main Board A4

FUNCTION	WAFER S2A to A4 Pin	WAFER S2B to A4 Pin	WAFER S2C to A5	WAFER S2DR to A5	WAFER S2E to A4 Pin
PERIOD: 1	9	6	#3	MS	NONE
10	E	6	#2	MS	14
100	D	6	#1	MS	13, 14
1K	C	6	#3	μS	NC
10K	B	6	#2	μS	14
100K	A	6	#1	μS	13, 14
FREQ: .01	D	8	#3	MHz	14
.1	C	8	#2	MHz	13, 14
1	B	8	#1	kHz	NC
10	A	8	#2	kHz	14
MANUAL START	L	8	NONE	A4(J)	13, 14
MANUAL STOP	M + STOP BNC	8	NONE	NC	13, 14
GROUNDED TO ACTIVATE FUNCTION AS SHOWN					+5V ON

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and HP part number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their HP part number and provides the following information on each part.

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Sales and Service office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	F = fuse	MP = mechanical part	U = integrated circuit
B = motor	FL = filter	P = plug	V = vacuum, tube, neon bulb, photocell, etc.
BT = battery	IC = integrated circuit	Q = transistor	
C = capacitor	J = jack	R = resistor	VR = voltage regulator
CP = coupler	K = relay	RT = thermistor	W = cable
CR = diode	L = inductor	S = switch	X = socket
DL = delay line	LS = loud speaker	T = transformer	Y = crystal
DS = device signaling (lamp)	M = meter	TB = terminal board	Z = tuned cavity, network
E = misc electronic part	MK = microphone	TP = test point	

ABBREVIATIONS

A = amperes	H = henries	N/O = normally open	RMO = rack mount only
AFC = automatic frequency control	HDW = hardware	NOM = nominal	RMS = root-mean square
AMPL = amplifier	HEX = hexagonal	NPO = negative positive zero (zero temperature coefficient)	RWV = reverse working voltage
	HG = mercury		
BFO = beat frequency oscillator	HR = hour(s)		S-B = slow-blow
BE CU = beryllium copper	HZ = hertz	NPN = negative-positive-negative	SCR = screw
BH = binder head			SE = selenium
BP = bandpass	IF = intermediate freq	NRFR = not recommended for field replacement	SECT = section(s)
BRS = brass	IMPG = impregnated		SEMICON = semiconductor
BWO = backward wave oscillator	INCD = incandescent	NSR = not separately replaceable	SI = silicon
	INCL = include(s)		SIL = silver
CCW = counter-clockwise	INS = insulation(ed)	OBD = order by description	SL = slide
CER = ceramic	INT = internal	OH = oval head	SPG = spring
CMO = cabinet mount only	K = kilo = 1000	OX = oxide	SPL = special
COEF = coefficient			SST = stainless steel
COM = common	LH = left hand	P = peak	SR = split ring
COMP = composition	LIN = linear taper	PC = printed circuit	STL = steel
COMPL = complete	LK WASH = lock washer	PF = picofarads = 10^{-12} farads	TA = tantalum
CONN = connector	LOG = logarithmic taper		TD = time delay
CP = cadmium plate	LPF = low pass filter	PH BRZ = phosphor bronze	TGL = toggle
CRT = cathode-ray tube		PHL = Phillips	THD = thread
CW = clockwise	M = milli = 10^{-3}	PIV = peak inverse voltage	TI = titanium
	MEG = meg = 10^{6}	PNP = positive-negative-positive	TOL = tolerance
DEPC = deposited carbon	MET FLM = metal film		TRIM = trimmer
DR = drive	MET OX = metallic oxide	P/O = part of	TWT = traveling wave tube
	MFR = manufacturer	POLY = polystyrene	
ELECT = electrolytic	MHZ = mega hertz	PORC = porcelain	U = micro = 10^{-6}
ENCAP = encapsulated	MINAT = miniature	POS = position(s)	
EXT = external	MOM = momentary	POT = potentiometer	VAR = variable
	MOS = metal ozide substrate	PP = peak-to-peak	VDCW = dc working volts
F = farads	MTG = mounting	PT = point	
FH = flat head	MY = "mylar"	PWV = peak working voltage	W/ = with
FIL H = fillister head			W = watts
FXD = fixed	N = nano (10^{-9})	RECT = rectifier	WIV = working inverse voltage
G = giga (10^{9})	N/C = normally closed	RF = radio frequency	
GE = germanium	NE = neon	RH = round head or right hand	WW = wirewound
GL = glass	NI PL = nickel plate		W/O = without
GRD = ground(ed)			

01194-14

Table 6-1. Reference Designation Index

Reference Designation	Part No.	Description #	Note
A1	05216-6005	ASSY:ATTENUATOR SWITCH	
	05216-0001	CASE:ATTEN SWITCH	
	5040-0218	COUPLER:SWITCH SHAFT	
	0370-0134	KNOB:ROUND FOR 0.125" DIA SHAFT	
	0370-0099	KNOB:SKIRTED BAR 5/8 DIA	
	05216-0005	COVER ATTEN SWITCH	
	0340-0039	INSULATOR:BUSHING	
	0340-0038	FEEDTHRU:TERMINAL	
	0340-0037	POST:TERMINAL	
A1C1	0160-2263	C:FXD CER 18 PF 5% 500VDCW	
A1C2	0160-2241	C:FXD CER 2.2-0.25 PF 500VDCW	
A1C3	0160-2264	C:FXD CER 20 PF 5% 500VDCW	
A1C4	0140-0213	C:FXD MICA 2000 PF 1%	
A1C5	0160-2262	C:FXD CER 16 PF 5% 500VDCW	
A1C6	0160-2239	C:FXD CER 1.8-0.25 PF 500VDCW	
A1C7	0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	
A1CR1	1901-0040	DIODE:SILICON	
A1CR2	1901-0040	DIODE:SILICON	
A1P1	1251-0028	PLUG:BANANA MALE	
A1R1	0757-0350	R:FXD MET FLM 909K OHM 1% 1/4W	
A1R2	0757-0776	R:FXD MET FLM 110K OHM 1% 1/4W	
A1R3	0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	
A1R4	0757-0340	R:FXD MET FLM 10.0K OHM 1% 1/4W	
A1R5	0757-0350	R:FXD MET FLM 909K OHM 1% 1/4W	
A1R6	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A1R7	0757-0776	R:FXD MET FLM 110K OHM 1% 1/4W	
A1R8	0683-7515	R:FXD COMP 750 OHM 5% 1/4W	
A1R9	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A1R10	2100-2056	R:VAR COMP 2K OHM 20% LIN 2.25W	
A1S1	3100-2058	SWITCH:ROTARY	
A2	05216-6003	ASSY:AMPLIFIER BOARD	
	05216-2003	BOARD:BLANK PC	
A2C1	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A2C2	0160-2255	C:FXD CER 8.2 0.25 PF 500VDCW	
A2C3	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A2C4	0180-0229	C:FXD ELECT 33 UF 10% 10VDCW	
A2C5	0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	
A2C6	0180-0229	C:FXD ELECT 33 UF 10% 10VDCW	
A2C7	0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	
A2C8	0160-2257	C:FXD CER 10 PF 5% 500VDCW	
A2C9	0160-2199	C:FXD MICA 30 PF 5%	
A2C10	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A2C11	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2CR1	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR2	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR3	1901-0040	DIODE:SILICON 30MA 30WV	
A2Q1	1855-0053	Q:SI FET N-CHAN	
A2Q2	1853-0036	Q:SI PNP	
A2Q3	1854-0215	Q:SI NPN	
A2Q4	1853-0034	Q:SI PNP(SELECTED FROM 2N3251)	
A2Q5	1854-0215	Q:SI NPN	
A2Q6	1853-0034	Q:SI PNP(SELECTED FROM 2N3251)	
A2Q7	1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	
A2Q8	1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	
A2Q9	1854-0215	Q:SI NPN	
A2Q10	1853-0036	Q:SI PNP	
A2Q11	1853-0036	Q:SI PNP	
A2R1	0683-4715	R:FXD COMP 470 OHM 5% 1/4W	
A2R2	0684-1051	R:FXD COMP 1MEGOHM 1% 1/4W	
A2R3	0757-0927	R:FXD FLM 1.3K OHM 2% 1/8W	
A2R4	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A2R5	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
A2R6	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A2R7	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A2R8	0757-0905	R:FXD FLM 160 OHM 2% 1/8W	
A2R9	0757-0925	R:FXD FLM 1.1K OHM 2% 1/8W	
A2R10	0757-0942	R:FXD FLM 5.6K OHM 2% 1/8W	
A2R11	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A2R12	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A2R13	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
A2R14	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A2R15	0757-0905	R:FXD FLM 160 OHM 2% 1/8W	
A2R16	0757-0942	R:FXD FLM 5.6K OHM 2% 1/8W	
A2R17	0757-0925	R:FXD FLM 1.1K OHM 2% 1/8W	
A2R18	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A2R19	0757-0914	R:FXD FLM 390 OHM 2% 1/8W	
A2R20	0683-1135	R:FXD COMP 11K OHM 5% 1/4W	
A2R21	0757-0914	R:FXD FLM 390 OHM 2% 1/8W	
A2R22	0757-0926	R:FXD FLM 1.2K OHM 2% 1/8W	
A2R23	0757-0916	R:FXD MET FLM 470 OHM 2% 1/8W	
A2R24	0683-6815	R:FXD COMP 680 OHM 5% 1/4W	
A2R25	0757-0915	R:FXD MET FLM 430 OHM 2% 1/8W	
A2R26	0757-0949	R:FXD FLM 11K OHM 2% 1/8W	
A2R27	0757-0943	R:FXD FLM 6.2K OHM 2% 1/8W	
A3	05216-6010	OSCILLATOR ASSY	

See introduction to this section for ordering information

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Table 6-1. Reference Designation Index (Continued)

Reference Designation	Part No.	Description #	Note
	05216-2010	BOARD:BLANK PC	
A3C1	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C2	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C3	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A3C4	0140-0198	C:FXD MICA 200 PF 5%	
A3C5	0121-0178	C:VAR CER 15-60 PF	
A3C6	0160-2306	C:FXD MICA 27 PF 5%	
A3C7	0160-2538	C:FXD MICA 400 PF 1% 300VDCW	
A3C8	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A3C9	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C10	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3L1	9100-1660	COIL/CHOKE 2000 UH 5%	
A3Q1	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A3Q2	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A3R1	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A3R2	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R3	0683-2015	R:FXD COMP 200 OHM 5% 1/4W	
A3R4	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A3R5	0683-1335	R:FXD COMP 13K OHM 5% 1/4W	
A3R6	0683-6825	R:FXD COMP 6800 OHM 5% 1/4W	
A3R7	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A3R8	0683-5105	R:FXD COMP 51 OHM 5% 1/4W	
A3R9	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3Y1	0410-0142	CRYSTAL:QUARTZ 1.0 MHZ	
	1200-0159	CRYSTAL HOLDER	
A4	05216-6013	BOARD ASSY:COUNTER	
	05216-2013	BOARD:BLANK PC	
A4C1	0180-0210	C:FXD ELECT 3.3 UF 20% 15VDCW	
A4C2	0160-2249	C:FXD CER 4.7-0.25 PF 500VDCW	
A4C3	0160-2197	C:FXD MICA 10 PF 5%	
A4C4	0160-2197	C:FXD MICA 10 PF 5%	
A4C5	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4C6	0160-0342	C:FXD MICA 800 PF 1% 300VDCW	
A4C7	0180-0393	C:FXD ELECT 39 UF 10% 10VDCW	
A4C8	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A4C9	0160-2197	C:FXD MICA 10 PF 5%	
A4C10	0160-2250	C:FXD CER 5.1-0.25 PF 500VDCW	
A4C11	0160-2197	C:FXD MICA 10 PF 5%	
A4C12	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A4CR1	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR2	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR3	1910-0030	DIODE:GERMANIUM 100 MA 0.65V	
A4CR4	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR5	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR6	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR7	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR8	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR9	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR10	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR11	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR12	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR13	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR14	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR15	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR16	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR17	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR18	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR19	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR20	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR21	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR22	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR23	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR24	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR25	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR26	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4CR27	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
A4DS1	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS2	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS3	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS4	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS5	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS6	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4DS7	1970-0025	ELECTRON TUBE:NIXIE INDICATOR	
A4IC1	1820-0412	INTEGRATED CIRCUIT:DECADE DIVIDER	
A4IC2A	1820-0412	INTEGRATED CIRCUIT: DECADE DIVIDER	
A4IC2B	1820-0412	INTEGRATED CIRCUIT:DUAL DECADE DIVIDER	
A4IC3B	1820-0198	INTEGRATED CIRCUIT:DUAL DECADE DIVIDER	
A4IC4B	1820-0198	INTEGRATED CIRCUIT:DUAL DECADE DIVIDER	
A4IC5	1820-0072	INTEGRATED CIRCUIT:TTL	
A4IC6	1820-0054	IC:TTL QUAD 2-INPUT NAND GATE	
A4IC7	1820-0065	INTEGRATED CIRCUIT: TTL	
	1200-0415	SOCKET:IC 14 PIN	
A4IC8	1820-0174	INTEGRATED CIRCUIT:TTL HEX INVERTER	
A4IC9	1820-0075	IC:TTL DUAL MASTER/SLAVE FF	
	1200-0415	SOCKET:IC 14 PIN	
A4IC10	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC11	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC12	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC13	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC3A	1820-0412	INTEGRATED CIRCUIT:DECADE DIVIDER	
A4IC4A	1820-0412	INTEGRATED CIRCUIT:DECADE DIVIDER	

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Table 6-1. Reference Designation Index (Continued)

Reference Designation	Part No.	Description #	Note
A4IC14	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC15	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC16	1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	
A4IC17	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC18	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC19	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC20	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC21	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC22	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC23	1820-0116	IC:4-BIT BUFF STORE GATED OUTS	
A4IC24	1820-0119	INTEGRATED CIRCUIT	
A4IC25	1820-0119	INTEGRATED CIRCUIT	
A4IC26	1820-0119	INTEGRATED CIRCUIT	
A4IC27	1820-0119	INTEGRATED CIRCUIT	
A4IC28	1820-0119	INTEGRATED CIRCUIT	
A4IC29	1820-0119	INTEGRATED CIRCUIT	
A4IC30	1820-0117	INTEGRATED CIRCUIT	
A4Q1	1854-0009	Q:SI NPN	
A4Q2	1854-0009	Q:SI NPN	
A4Q3	1854-0009	Q:SI NPN	
A4Q4	1854-0009	Q:SI NPN	
A4Q5	1854-0009	Q:SI NPN	
A4Q6	1854-0009	Q:SI NPN	
A4Q7	1854-0009	Q:SI NPN	
A4Q8	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A4Q9	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A4Q10	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A4Q11	1854-0009	Q:SI NPN	
A4Q12	1854-0009	Q:SI NPN	
A4Q13	1854-0009	Q:SI NPN	
A4Q14	1854-0009	Q:SI NPN	
A4Q15	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A4Q16	1854-0365	Q:SI NPN	
A4R1	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R2	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A4R3	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R4	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A4R5	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
A4R6	0683-7525	R:FXD COMP 7500 OHM 5% 1/4W	
A4R7	0683-3905	R:FXD COMP 39 UHM 5% 1/4W	
A4R8	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
A4R9	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A4R10	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A4R11	0683-5115	R:FXD COMP 510 UHM 5% 1/4W	
A4R12	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A4R13	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R14	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R15	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R16	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R17	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R18	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A4R19	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R20	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R21	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A4R22	0683-5625	R:FXD COMP 5600 OHM 5% 1/4W	
A4R23	0683-5105	R:FXD COMP 51 UHM 5% 1/4W	
A4R24	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	
A4R25	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R26	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A4R27	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A4R28	0683-3915	R:FXD COMP 390 OHM 5% 1/4W	
A4R29	0683-1015	R:FXD COMP 100 UHM 5% 1/4W	
A4R30	0683-2735	R:FXD COMP 27K OHM 5% 1/4W	
A4R31	0683-4715	R:FXD COMP 470 UHM 5% 1/4W	
A4R32	0683-4715	R:FXD COMP 470 OHM 5% 1/4W	
A4R33	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R34	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A4R35	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R36	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R37	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R38	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A4R39	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R40	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R41	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R42	0683-1005	R:FXD COMP 10 UHM 5% 1/4W	
A4R43	0683-4325	R:FXD COMP 4300 OHM 5% 1/4W	
A4R44	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R45	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R46	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R47	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R48	0683-5115	R:FXD COMP 510 UHM 5% 1/4W	
A4R49	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	
A4R50	0683-6835	R:FXD COMP 68K OHMS 5% 1/4W	
A4R51	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R52	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R53	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R54	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R55	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R56	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R57	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
A4R58	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A4R59	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A5	05216-6004	ASSY:DECIMAL BOARD	
	05216-2004	BOARD:BLANK PC	
A5DS1	2140-0028	LAMP:GLOW 1/15W	

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Table 6-1. Reference Designation Index (Continued)

Reference Designation	Part No.	Description #	Note
A5DS2	2140-0028	LAMP:GLOW 1/15W	
A5DS3	2140-0028	LAMP:GLOW 1/15W	
A5DS4	2140-0028	LAMP:GLOW 1/15W	
A5DS5	2140-0028	LAMP:GLOW 1/15W	
A5DS6	2140-0028	LAMP:GLOW 1/15W	
A5DS7	2140-0028	LAMP:GLOW 1/15W	
A5R1	0684-8231	R:FXD COMP 82K OHM 10% 1/4W	
A5R2	0684-8231	R:FXD COMP 82K OHM 10% 1/4W	
A6	05216-6012	BOARD ASSY:POWER SUPPLY	
	05216-2012	BOARD:BLANK PC	
A6C1	0180-1972	C:FXD ELECT 3400 UF +75-10% 50VDCW	
A6C2	0180-2101	C:FXD ELECT 4000 UF +75-10% 15VDCW	
A6C3	0180-2100	C:FXD ELECT 1200 UF +75-10% 15VDCW	
A6C4	0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	
A6C5	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW	
A6C6	0160-0147	C:FXD MICA 2500PF 2% 300VDCW	
A6C7	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW	
A6C8	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW	
A6C9	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW	
A6CR1	1901-0029	DIODE:SILICON 600 PIV	
A6CR2	1901-0029	DIODE:SILICON 600 PIV	
A6CR3	1901-0029	DIODE:SILICON 600 PIV	
A6CR4	1901-0029	DIODE:SILICON 600 PIV	
A6CR5	1901-0045	DIODE:SILICON 0.75A 100PIV	
A6CR6	1901-0045	DIODE:SILICON 0.75A 100PIV	
A6CR7	1901-0045	DIODE:SILICON 0.75A 100PIV	
A6CR8	1901-0045	DIODE:SILICON 0.75A 100PIV	
A6CR9	1901-0415	DIODE:SILICON 50 PIV 3A	
A6CR10	1901-0415	DIODE:SILICON 50 PIV 3A	
A6CR11	1901-0415	DIODE:SILICON 50 PIV 3A	
A6CR12	1901-0415	DIODE:SILICON 50 PIV 3A	
A6CR13	1902-3429	DIODE BREAKDOWN:100 V 2%	
A6CR14	1902-3100	DIODE BREAKDOWN: 5.36V +2%	
A6CR15	1901-0040	DIODE:SILICON 30MA 30WV	
A6CR16	1902-3100	DIODE BREAKDOWN: 5.36V +2%	
A6CR17	1902-3059	DIODE BREAKDOWN:SILICON 3.83V 5%	
A6CR18	1902-3094	DIODE BREAKDOWN: 5.11V +2%	
A6CR19	1902-3094	DIODE BREAKDOWN: 5.11V +2%	
A6Q1	1854-0232	Q:SI NPN(SELECTED FROM 2N3440)	
A6Q2	1853-0015	Q:SI PNP	
A6Q3	1853-0012	Q:SI PNP	
A6Q4	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A6Q5	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A6Q6	1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	
A6Q7	1853-0012	Q:SI PNP	
A6R1	0683-3935	R:FXD COMP 39K OHM 5% 1/4W	
A6R2	0686-5135	R:FXD COMP 51K OHM 5% 1/2W	
A6R3	0683-2005	R:FXD COMP 20 OHM 5% 1/4W	
A6R4	0683-1525	R:FXD COMP 1.5K OHM 5% 1/4W	
A6R5	0683-1505	R:FXD COMP 15 OHM 5% 1/4W	
A6R6	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A6R7	0683-1315	R:FXD COMP 130 OHM 5% 1/4W	
A6R8	0686-7505	R:FXD COMP 75 OHM 5% 1/2W	
A6R9	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	
A6R10	2100-1756	R:VAR WW 200 OHM 5% TYPE V 1W	
A6R11	0683-3615	R:FXD COMP 360 OHM 5% 1/4W	
A6RT1	0839-0021	THERMISTOR:DISC 500 OHM 10%	
		CHASSIS PARTS	
C1	0160-0380	C:FXD MY 0.22 UF 10% 200VDCW	
C2	0160-3043	C:FXD CER 2 X 0.005 UF 20% 250WVAC	
CR1	1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	
CR2	1902-3428	DIODE BREAKDOWN:SILICON 100V 5%	
DS1	2140-0018	LAMP:GLOW 1/10W	
DS1	5040-0235	BASE:LAMPHOLDER	
DS1	5040-0234	LAMPHOLDER	
F1	2110-0018	FUSE:CARTRIDGE 0.25 AMP SLOW BLOW	
F1		FOR 115 VOLT OPERATION	
F1	2110-0017	FUSE:CARTRIDGE 0.15 AMP SLOW BLOW	
F1		FOR 230 VOLT OPERATION	
F1	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
J1	1250-0083	CONNECTOR:BNC	
J2	1250-0083	CONNECTOR:BNC	
J3	1250-0083	CONNECTOR:BNC	
J4	1250-0083	CONNECTOR:BNC	
J5	1250-0083	CONNECTOR:BNC	
J6	1250-0083	CONNECTOR:BNC	
J7	1251-0148	CONNECTOR:POWER 3 PIN MALE	
L1	9140-0136	COIL:FXD RF 22 UH	
L2	9140-0136	COIL:FXD RF 22 UH	
Q1	1854-0063	Q:SI NPN	
Q1	1200-0043	INSULATOR:TRANSISTOR MOUNTING	
R1	2100-0318	R:VAR 250K OHM 20% 1/4W/SPST SW	
R1	0370-0103	KNOB:BLK W/ARROW 5/8" OD 1/4" SHAFT	
S1		NSR PART OF R1	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Continued)

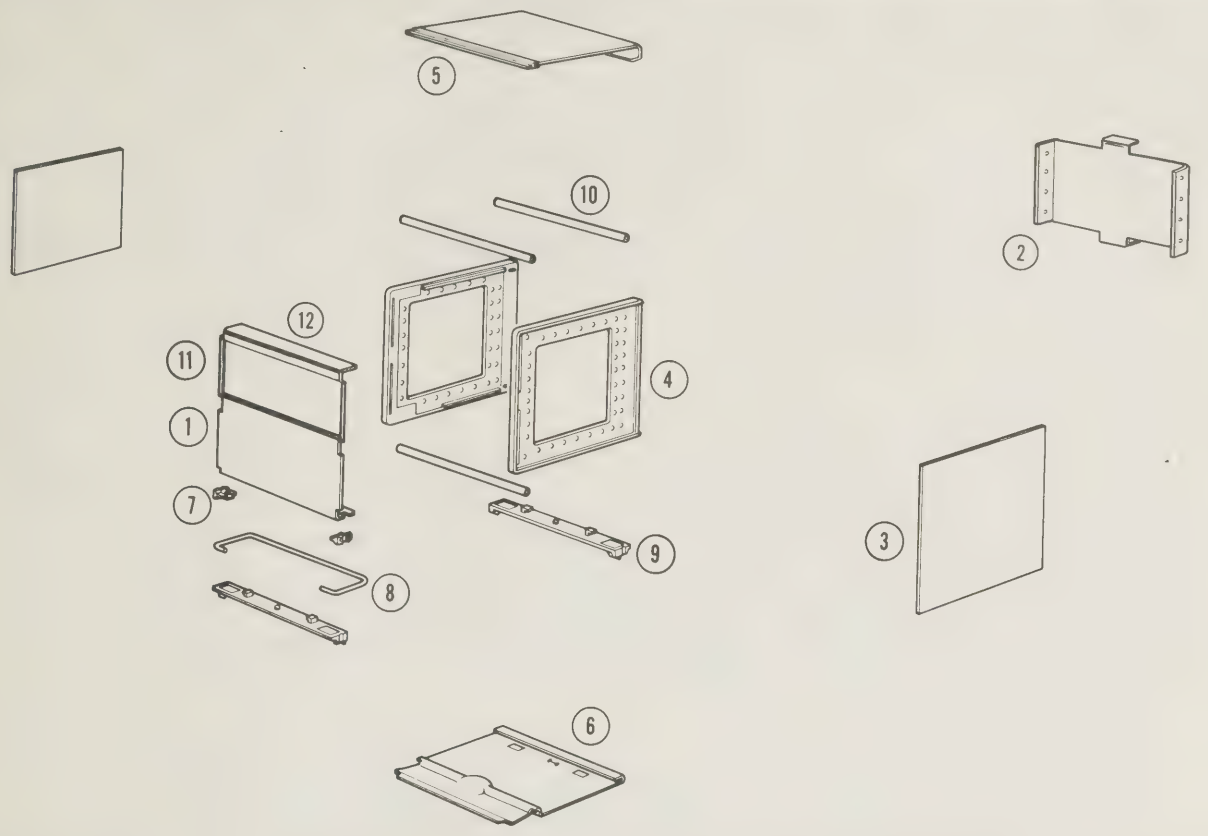
Reference Designation	Part No.	Description #	Note
S7	3100-2057	SWITCH:ROTARY	
S2	0370-0677	KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT	
S3	3101-0052	SWITCH:PUSHBUTTON SPST	
S4	3101-0033	SWITCH:SLIDE DPDT 0.5A 125AC/DC	
S5	3101-0957	SWITCH:TOGGLE DPDT	
S6	3101-0954	SWITCH:TOGGLE DPDT	
S7	3101-0163	SWITCH:TOGGLE SPDT	
T1	9100-3004	TRANSFORMER	
W1	8120-0078	CABLE ASSY:POWER CORD	
W2	05216-6007	CABLE:MAIN	
W3	05216-6014	CABLE ASSY:GATE LIGHT	
W4	05216-6008	CABLE:REAR INPUT	
XA1		NOT ASSIGNED	
XA2	1251-3195	CONNECTOR:PRINTED CIRCUIT 10-CONTACT	
XA3	1251-3138	CONNECTOR:6-CONTACT	
XA4	1251-0159	CONNECTOR:2X15 CONTACT	
XA5		NOT ASSIGNED	
XA6	1251-3194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	
		MISCELLANEOUS	
	05216-8001	WINDOW:UNITS DISPLAY	
	05216-4008	GROUND:CONNECTOR	
	05216-4007	SOCKET:CONNECTOR	
	05216-4002	INSERT:READOUT	
	05216-4001	CASE:COUNTER	
	05216-4006	HOLDER:POWER SUPPLY	
	05216-4005	LIGHT:PIPE	
	05216-4003	WINDOW	
	0380-0093	STANDOFF:6-32 X 1/2	
	5040-0700	HINGE	

See introduction to this section for ordering information

Reference Designation	Part No.	Description #	Note
		CABINET PARTS	
1	05216-0002	PANEL:FRONT	1
2	05216-0004	PANEL:REAR	1
3	5060-0702	SIDE COVER	2
4	5060-0702	FRAME ASSEMBLY	2
5	5060-0723	COVER:TOP	1
6	5040-0718	COVER:BOTTOM	1
7	5040-0700	HINGE	2
8	1490-0032	STAND:TILT HALF-MODULE	1
9	5060-0728	FOOT ASSY:HALF MODULE	2
10	5020-0701	CABINET SPACER	2
11	05216-4004	FRAME:WINDOW	1
12	05216-0003	BEZEL	1

See introduction to this section for ordering information

Figure 6-1. Cabinet Parts



Item No.	Description	HP Part No.	Quantity
1	Front Panel	05216-0002	1
2	Rear Panel	05216-0004	1
3	Side Cover	5000-0702	2
4	Side Frame	5060-0702	2
5	Top Cover	5060-0723	1
6	Bottom Cover	5060-0718	1
7	Hinge	5040-0700	2
8	Tilt Stand	1490-0032	1
9	Foot Assembly	5060-0728	2
10	Spacer	5020-0701	2
11	Window Frame	05216-4004	1
12	Bezel	05216-0003	1

Table 6-2. Replaceable Parts Index

⊛ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0121-0178	C:VAR CER 15-60 PF	28480	0121-0178	1
0140-0198	C:FXD MICA 200 PF 5%	72136	RDM15F201J3C	1
0140-0213	C:FXD MICA 2000 PF 1%	28480	0140-0213	1
0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZE19-CDH	1
0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA	4
0160-3043	C:FXD CER 2 X 0.005 UF 20% 250WVAC	56289	29C147A-CD8	1
0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML	2
0160-0147	C:FXD MICA 2500PF 2% 300VDCW	04062	RDM20F252G3S	1
0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	56289	192P33392-P1S	1
0160-0342	C:FXD MICA 800 PF 1% 300VDCW	04062	RDM15F801F3C	1
0160-0380	C:FXD MY 0.22 UF 10% 200VDCW	28480	0160-0380	1
0160-2197	C:FXD MICA 10 PF 5%	72136	RDM15C100J3C	4
0160-2199	C:FXD MICA 30 PF 5%	28480	0160-2199	1
0160-2239	C:FXD CER 1.8-0.25 PF 500VDCW	72982	301-000-C0K0-189C	1
0160-2241	C:FXD CER 2.2-0.25 PF 500VDCW	72982	301-000-C0J0-229C	1
0160-2249	C:FXD CER 4.7-0.25 PF 500VDCW	72982	301-NP0-4.7 PF	1
0160-2250	C:FXD CER 5.1-0.25 PF 500VDCW	72982	301-000-C0H0-519E	1
0160-2255	C:FXD CER 8.2 0.25 PF 500VDCW	28480	0160-2255	1
0160-2257	C:FXD CER 10 PF 5% 500VDCW	72982	301-000-C0H0-100J	1
0160-2262	C:FXD CER 16 PF 5% 500VDCW	72982	301-000 C0G0 160J	1
0160-2263	C:FXD CER 18 PF 5% 500VDCW	72982	301-000-C0G0-180J	1
0160-2264	C:FXD CER 20 PF 5% 500VDCW	72982	301-000-C0G0-200J	1
0160-2306	C:FXD MICA 27 PF 5%	28480	0160-2306	1
0160-2548	C:FXD MICA 400 PF 1% 300VDCW	04062	RDM15F401F3S	1
0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW	28480	0180-0032	4
0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	56289	150D107X0010R2-DYS	2
0180-0210	C:FXD ELECT 3.3 UF 20% 15VDCW	82376	IES 3.3M-15	2
0180-0229	C:FXD ELECT 33 UF 10% 10VDCW	28480	0180-0229	3
0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS	7
0180-1972	C:FXD ELECT 3400 UF +75-10% 50VDCW	56289	36D343G050DF2B-DQB	1
0180-0393	C:FXD ELECT 39 UF 10% 10 VDCW	56289	150D396X9010B2-DYS	1
0180-2101	C:FXD ELECT 4000 UF +75-10% 15VDCW	28480	0180-2101	1
0180-2102	C:FXD ELECT 700 UF +75-10% 25VDCW	28480	0180-2102	1
0340-0037	POST:TERMINAL	28480	0340-0037	2
0340-0038	FEEDTHRU:TERMINAL	28480	0340-0038	1
0340-0039	INSULATOR:BUSHING	28480	0340-0039	1
0370-0077	KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT	28480	0370-0077	1
0370-0099	KNOB:SKIRTED BAR 5/8 DIA	28480	0370-0099	1
0370-0103	KNOB:BLK W/ARROW 5/8" OD 1/4" SHAFT	28480	0370-0103	1
0370-0134	KNOB:ROUND FOR 0.125" DIA SHAFT	28480	0370-0134	1
0380-0093	STANDOFF:6-32 X 1/2	00866	1951E	1
0410-0142	CRYSTAL:QUARTZ 1.0 MHZ	28480	0410-0142	1
0683-1005	R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005	1
0683-1015	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015	3
0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025	13
0683-1035	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035	20
0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045	2
0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	01121	CB 1225	3
0683-1235	R:FXD COMP 12K OHM 5% 1/4W	01121	CB 1235	2
0683-1315	R:FXD COMP 130 OHM 5% 1/4W	01121	CB 1315	1
0683-1335	R:FXD COMP 13K OHM 5% 1/4W	01121	CB 1335	1
0683-1525	R:FXD COMP 1.5K OHM 5% 1/4W	01121	CB 1525	1
0683-1505	R:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505	1
0683-1535	R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535	1
0683-1835	R:FXD COMP 18K OHM 5% 1/4W	01121	CB 1835	1
0683-2015	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015	1
0683-1135	R:FXD COMP 11K OHMS 5% 1/4W	01121	CB 1135	1

See introduction to this section for ordering information

⊛ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0683-2025	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025	6
0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725	3
0683-2735	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735	1
0683-3615	R:FXD COMP 360 OHM 5% 1/4W	01121	CB 3615	1
0683-3935	R:FXD COMP 39K OHM 5% 1/4W	01121	CB 3935	1
0683-3905	R:FXD COMP 39 OHM 5% 1/4W	01121	CB 3905	1
0683-3915	R:FXD COMP 390 OHM 5% 1/4W	01121	CB 3915	1
0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925	2
0683-4325	R:FXD COMP 4300 OHM 5% 1/4W	01121	CB 4325	1
0683-4715	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715	3
0683-5105	R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105	2
0683-5115	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115	5
0683-5125	R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125	7
0683-5625	R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625	1
0683-6815	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815	1
0683-6835	R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835	1
0683-6825	R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825	1
0683-7525	R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525	1
0684-1051	R:FXD COMP 1MEGOHM 1% 1/4W	01121	CB 1051	1
0684-8231	R:FXD COMP 82K OHM 10% 1/4W	01121	CB 8231	2
0686-5135	R:FXD COMP 51K OHM 5% 1/2W	01121	EB 5135	1
0686-7505	R:FXD COMP 75 OHM 5% 1/2W	01121	EB 7505	1
0757-0340	R:FXD MET FLM 10.0K OHM 1% 1/4W	28480	0757-0340	1
0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344	1
0757-0350	R:FXD MET FLM 909K OHM 1% 1/4W	28480	0757-0350	2
0757-0776	R:FXD MET FLM 110K OHM 1% 1/4W	28480	0757-0776	2
0757-0905	R:FXD FLM 160 OHM 2% 1/8W	28480	0757-0905	2
0757-0914	R:FXD FLM 390 OHM 2% 1/8W	28480	0757-0914	2
0757-0916	R:FXD MET FLM 470 OHM 2% 1/8W	14674	C4	2
0757-0925	R:FXD FLM 1.1K OHM 2% 1/8W	28480	0757-0925	2
0757-0926	R:FXD FLM 1.2K OHM 2% 1/8W	28480	0757-0926	1
0757-0927	R:FXD FLM 1.3K OHM 2% 1/8W	28480	0757-0927	1
0757-0942	R:FXD FLM 5.6K OHM 2% 1/8W	28480	C4	2
0757-0943	R:FXD FLM 6.2K OHM 2% 1/8W	28480	0757-0943	1
0757-0949	R:FXD FLM 11K OHM 2% 1/8W	28480	0757-0949	1
0839-0021	THERMISTOR:DISC 500 OHM 10%	83186	25E11	1
1200-0043	INSULATOR:TRANSISTOR MOUNTING	71785	293011	1
1200-0159	CRYSTAL HOLDER	28480	1200-0159	1
1200-0415	SOCKET:IC 14 PIN	95354	M-1141	2
1250-0083	CONNECTOR:BNC	28480	1250-0083	6
1251-0028	PLUG:BANANA MALE	78947	154689UF34	1
1251-0148	CONNECTOR:POWER 3 PIN MALE	87930	1065-1	1
1251-0158	CONNECTOR:6-CONTACT	28480	1251-0158	1
1251-0159	CONNECTOR:2X15 CONTACT	28480	1251-0159	1
1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	28480	1251-0194	1
1251-0195	CONNECTOR:PRINTED CIRCUIT 10-CONTACT	28480	1251-0195	1
1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	79515	342014	1
1490-0032	STAND:TILT HALF-MODULE	28480	1490-0032	1
1820-0054	IC:TTL QUAD 2-INPUT NAND GATE	01295	SN5342	1
1820-0065	INTEGRATED CIRCUIT: TTL	01295	SN7470N	1
1820-0072	INTEGRATED CIRCUIT:TTL	01295	SN5347	1
1820-0075	IC:TTL DUAL MASTER/SLAVE FF	01295	SN5353	1
1820-0092	INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092	7
1820-0116	IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116	7

See introduction to this section for ordering information

Table 6-2. Replaceable Parts Index (Continued)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
1820-0117	INTEGRATED CIRCUIT	28480	1820-0117	1
1820-0119	INTEGRATED CIRCUIT	28480	1820-0119	6
1820-0174	INTEGRATED CIRCUIT:TTL HEX INVERTER	01295	SN8199	1
1820-0412	INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412	7
1853-0012	Q:SI PNP	04713	2N2904A	2
1853-0015	Q:SI PNP	04713	MPS3640-5	1
1853-0034	Q:SI PNP(SELECTED FROM 2N3251)	28480	1853-0034	2
1853-0036	Q:SI PNP	04713	SPS 3612	3
1854-0009	Q:SI NPN	04713	2N709	11
1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	28480	1854-0019	2
1854-0063	Q:SI NPN	04713	2N3055	1
1854-0071	Q:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071	9
1854-0215	Q:SI NPN	04713	SPS3611	3
1854-0232	Q:SI NPN(SELECTED FROM 2N3440)	28480	1854-0232	1
1854-0365	Q:SI NPN	04713	SPS 3321	1
1855-0053	Q:SI FET N-CHAN	28480	1855-0053	1
1901-0029	DIODE:SILICON 600 PIV	28480	1901-0029	4
1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1C88	9
1901-0045	DIODE:SILICON 0.75A 100PIV	04713	SR1358-7	4
1901-0050	DIODE:SILICON 75V	14433	S270	2
1901-0415	DIODE:SILICON 50 PIV 3A	28480	1901-0415	4
1902-3059	DIODE BREAKDOWN:SILICON 3.83V 5%	28480	1902-3059	1
1902-3100	DIODE BREAKDOWN: 5.36V +2%	04713	SZ10939-105	3
1902-3428	DIODE BREAKDOWN:SILICON 100V 5%	28480	1902-3428	1
1902-3429	DIODE BREAKDOWN:100 V 2%	28480	1902-3429	1
1910-0016	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361	22
1910-0030	DIODE:GERMANIUM 100 MA 0.65V	28480	1910-0030	1
1970-0025	ELECTRON TUBE:NIXIE INDICATOR	83594	B5560	7
2100-0318	R:VAR 250K OHM 20% 1/4W/SPST SW	28480	2100-0318	1
2100-1756	R:VAR WW 200 OHM 5% TYPE V 1W	28480	2100-1756	1
2100-2056	R:VAR COMP 2K OHM 20% LIN 2.25W	28480	2100-2056	1
2110-0017	FUSE:CARTRIDGE 0.15 AMP SLOW BLOW	75915	313.150	1
2110-0018	FUSE:CARTRIDGE 0.25 AMP SLOW BLOW	75915	313.250	1
2140-0018	LAMP:GLOW 1/10W	24455	NE 2E1	1
2140-0028	LAMP:GLOW 1/15W	24455	NE 2E FROSTED	7
3100-2057	SWITCH:ROTARY	28480	3100-2057	1
3100-2058	SWITCH:ROTARY	28480	3100-2058	1
3101-0033	SWITCH:SLIDE DPDT 0.5A 125AC/DC	82389	11A-1009A	1
3101-0052	SWITCH:PUSHBUTTON SPST	82389	961 LESS HWD	1
3101-0163	SWITCH:TOGGLE SPDT	04009	MST-105D	1
3101-0957	SWITCH:TOGGLE DPDT	28480	3101-0957	2
5000-0702	SIDE COVER	28480	5000-0702	2
5000-0718	COVER:BOTTOM	28480	5000-0718	1
5020-0701	CABINET SPACER	28480	5020-0701	2
5040-0218	COUPLER:SWITCH SHAFT	28480	5040-0218	1
5040-0234	LAMPHOLDER	28480	5040-0234	1
5040-0235	BASE:LAMPHOLDER	28480	5040-0235	1
5040-0700	HINGE	28480	5040-0700	3
5060-0702	FRAME ASSEMBLY	28480	5060-0702	2
5060-0723	COVER:TOP	28480	5060-0723	1
5060-0728	FOOT ASSY:HALF MODULE	28480	5060-0728	2
8120-0078	CABLE ASSY:POWER CORD	28480	8120-0078	1
9100-1660	COIL/CHOKE 2000 UH 5%	28480	9100-1660	1
9100-3004	TRANSFORMER	28480	9100-3004	1
9140-0136	COIL:FXD RF 22 UH	28480	9140-0136	2
05216-0001	CASE:ATTEN SWITCH	28480	05216-0001	1
05216-0002	PANEL:FRONT	28480	05216-0002	1
05216-0003	BEZEL	28480	05216-0003	1
05216-0004	PANEL:REAR	28480	05216-0004	1
05216-0005	COVER ATTEN SWITCH	28480	05216-0005	1
05216-2003	BOARD:BLANK PC	28480	05216-2003	1
05216-2004	BOARD:BLANK PC	28480	05216-2004	1
05216-2010	BOARD:BLANK PC	28480	05216-2010	1
05216-2012	BOARD:BLANK PC	28480	05216-2012	1
05216-2013	BOARD:BLANK PC	28480	05216-2013	1
05216-4001	CASE:COUNTER	28480	05216-4001	1
05216-4002	INSERT:READOUT	28480	05216-4002	1
05216-4003	WINDOW	28480	05216-4003	1
05216-4004	FRAME:WINDOW	28480	05216-4004	1
05216-4005	LIGHT:PIPE	28480	05216-4005	1
05216-4006	HOLDER:POWER SUPPLY	28480	05216-4006	1
05216-4007	SOCKET:CONNECTOR	28480	05216-4007	1
05216-4008	GROUND:CONNECTOR	28480	05216-4008	1
05216-6003	ASSY:AMPLIFIER BOARD	28480	05216-6003	1
05216-6004	ASSY:DECIMAL BOARD	28480	05216-6004	1
05216-6005	ASSY:ATTENUATOR SWITCH	28480	05216-6005	1
05216-6007	CABLE:MAIN	28480	05216-6007	1
05216-6008	CABLE:REAR INPUT	28480	05216-6008	1
05216-6010	OSCILLATOR ASSY	28480	05216-6010	1
05216-6012	BOARD ASSY:POWER SUPPLY	28480	05216-6012	1
05216-6013	BOARD ASSY:COUNTER	28480	05216-6013	1
05216-6014	CABLE ASSY:GATE LIGHT	28480	05216-6014	1
05216-8001	WINDOW:UNITS DISPLAY	28480	05216-8001	1

See introduction to this section for ordering information

See introduction to this section for ordering information

Table 6-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U. S. A. Common	Any supplier of U. S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N. Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N. Y.
00373	Garlock Inc.	Cherry Hill, N. J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N. J.
00809	Croven Ltd.	Whitby, Ontario Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S. C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N. J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N. Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01538	Small Parts Inc	Los Angeles, Calif
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N. Y.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N. Y.
02116	Wheelock Signals, Inc.	Long Branch, N. J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N. J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02875	Hudson Tool & Die Co.	Newark, N. J.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N. Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N. J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N. J.
04062	Arco Electronic Inc.	Great Neck, N. Y.
04[illegible]	Essex Wire	Los Angeles, Calif
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P. M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N. Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N. Y.
05729	Metro-Tel Corp.	Westbury, N. Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N. Y.
06402	E. T. A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N. Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N. H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N. Y.
07149	Filmohm Corp.	New York, N. Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N. Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N. J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N. J.
08145	U. S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N. J.
08792	CBS Electronics Semiconductor Operations, Div of C. B. S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N. Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N. Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N. J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N. J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N. M.
12697	Clarostat Mfg. Co.	Dover, N. H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N. J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N. J.
14674	Corning Glass Works	Corning, N. Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15106	The Sphere Co., Inc.	Little Falls, N. J.
15203	Webster Electronics Co.	New York, N. Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N. Y.
15566	Amprobe Inst. Corp.	Lynbrook, N. Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computer Diode Corp.	Lodi, N. J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N. Y.
16758	Delco Radio Div. of G. M. Corp.	Kokoma, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Ma.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17856	Siliconix Inc.	Sunnyvale, Calif.

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Table 6-3. Code List of Manufacturers (Continued)

Code No.	Manufacturer	Address
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Parelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialities Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78424	Speciality Leather Prod. Co.	Newark, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio

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Code No.	Manufacturer	Address
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96508	Xcelite Inc	Orchard Park, N.Y.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomson Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

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SECTION VII

MANUAL CHANGES

7-1. CURRENT INSTRUMENTS

7-2. This manual applies directly to Model 5216A Electronic Counters with serial prefix number 948 (refer to Paragraph 1-7).

7-3. NEWER INSTRUMENTS

7-4. As changes are made, newer instruments may have serial numbers not listed in this manual. The manuals for these instruments will be supplied with an additional "Manual Changes" sheet containing the required information; contact your nearest Hewlett-Packard Sales and Service office for information if this sheet is missing.

7-5. OLDER INSTRUMENTS

7-6. This manual with the changes listed in Table 7-1 also applies to 5216A Electronic Counters having serial prefix numbers 940 and below.

Table 7-1. Manual Changes

For Instrument Serial Prefix Number	Make Manual Changes
940	1
916	1, 2
748	1, 2, 3
744	1, 2, 3, 4
712 & 716	1, 2, 3, 4, 5

CHANGE 1:

Table 6-1:

Delete A4-05216-6013 Main Board Assembly and all lines prefixed by A4; replace with Table 7-2, A4-05216-6011 Main Board Assembly.

Delete A6-05216-6012 Power Supply Assembly and all lines prefixed by A6; replace with Table 7-3, A6-05216-6002 Power Supply Assembly.

Delete W3-05216-6014 Cable, Gate Light.

Change T1 from 9100-3004 Transformer to 9100-2438.

Delete A1C7 0150-0050 C:FXD 1000 pf.

Change A1R6 from 0683-1035 R:FXD 10K ohm to 0684-1011 R:FXD 100 ohm 5% 1/4W.

Change A1R8 from 0683-1035 R:FXD 10K ohm to 0683-2025 R:FXD 2K ohm 5% 1/4W.

Change A1CR1 and A1CR2 from 1901-0050 Diode to 1910-0016 Diode Germanium 60WIV.

Delete Figures 8-2, 8-3, 8-4, 8-5, 8-6, 8-9 (Sheets 1, 2, and 3) and 8-10. (Figures 8-2, 8-3, 8-4, and 8-5 will not be replaced.) Replace Figures 8-6, 8-9, and 8-10 with Figures 7-1, 7-2, 7-3, 7-4, and 7-5.

Replace A4 component locator photo (on Figure 8-9) for A4 schematic diagram with Figure 7-6.

CHANGE 2:

Table 7-2:

Add A4C5 0140-0221 C:FXD MICA 220 pf 1%
Add A4CR10 1910-0016 Diode:Germanium 100 MA

Delete Figure 7-3. Replace with Figure 7-7.

CHANGE 3:

Page 5-1, Table 5-1:

Change A3 to 10 MHz oscillator 05216-6006
Change A4 to Main Board 05216-6001

Page 5-5, Table 5-3:

Change TIME BASE to read as follows:

TIME BASE

1. TIME BASE FREQUENCY: 10 MHz
   STABILITY: Aging Rate: less than $\pm 2 \times 10^{-6}$/month
   Temperature: less than $\pm 1 \times 10^{-5}$ from +15°C to +35°C
   less than $\pm 3 \times 10^{-5}$ from 0°C to +50°C
   Line Voltage: less than 1×10^{-6} for ±10% change

   a. Connect output of Counter FREQ STD jack to Oscilloscope vertical input.

   b. Trigger Oscilloscope externally with a 1 MHz signal from a standard frequency source.

   c. Set Oscilloscope sweep time to 1 μs/cm.

   d. Horizontal drift of Oscilloscope in cm/sec is difference between standard frequency and counter time base frequency in parts in 10^6.

CHANGE 3 (Continued):

Page 5-5, Table 5-3 (Continued)

e. Record frequency difference. For long term stability, this test should be made daily for a period of one month.

NOTE: Temperature must be kept constant, or compensation for temperature difference must be made whenever a frequency difference is recorded. Unless a record of the temperature and date of last calibration is available, the frequency offset should not be considered drift or aging rate of the 10 MHz crystal.

f. Vary line voltage ± 10% and record frequency difference on test card.

NOTE: Stability as a function of temperature may be checked by performing steps g and h.

g. Vary operating temperature from +15°C to +35°C and record frequency difference.

h. Vary operating temperature from 0°C to +50°C and record frequency difference.

Page 5-8a-b, PERFORMANCE CHECK TEST CARD:

Change TIME BASE FREQUENCY to read as follows:

TIME BASE FREQUENCY: 10 MHz

1. Stability:	Aging Rate: less than $\pm 2 \times 10^{-6}$/month	less than $\pm 2 \times 10^{-6}$/mo.
	Temperature: less than $\pm 1 \times 10^{-5}$	
	from +15°C to +35°C	less than $\pm 1 \times 10^{-5}$
	less than $\pm 3 \times 10^{-5}$	
	from 0°C to +50°C	less than $\pm 3 \times 10^{-5}$
	Line Voltage: less than 1×10^{-6}	
	for ± 10% change	less than 1×10^{-6}

Table 6-1:
Delete A3-05216-6010 Oscillator Assembly and all lines refixed by A3; replace with Table 7-4, A3-05216-6006 Oscillator Assembly.

Table 7-2:
Change A4-05216-6011 to 05216-6001

Change 05216-2011 to 05216-2001

Add A4C3 0160-0168 C:FXD MY 0.1UF 10% 200VDCW.

Change A4CR26, A4CR27 to 1902-3404 Diode:Zener.

Change A4IC1, A4IC2, A4IC3, A4IC4, A4IC5, A5IC6, A4IC7, A4IC8 to 1820-0098 Circuit: Integrated.

Change A4R1, A4R2, A4R3, A4R4 to 0675-1021 R:FXD Carbon 1000 ohm 10% 1/8W.

Change A4R5 to 0683-1025 R:FXD COMP 1000 ohm 5% 1/4W.

Change A4R6 to 0675-1021 R:FXD Carbon 1000 ohm 10% 1/8W.

Change A4R10 to 0683-6815 R:FXD COMP 680 ohm 5% 1/4W.

Change A4R12 to 0698-5103 R:FXD COMP 530 ohm 5% 1/8W.

Replace Figure 7-2, 7-4, and 7-7 with Figures 7-7, 7-8, and 7-9 (respectively).

Replace Figure 8-6 with Figure 7-12.

CHANGE 4:

Figure 7-1:
Change A1R8 from 2000 ohms to 10K ohms.

Delete A1CR1 and A1CR2.

Table 6-1:
Change A1R8 to 0683-1035 R:FXD COMP 10K ohms 5% 1/4W.

Delete A1CR1 and A1CR2 (not assigned)

CHANGE 5:

Figure 7-8:
Change A4R10 from 680 ohms to 470 ohms

Figure 7-9:
Delete CR1 between XA4(J) and XA4(15).
Delete CR2 in parallel with DS1 (GATE light).

Figure 7-3:
Change A6R3 from 220 ohms to 430 ohms.

Table 7-2:
Change A4R10 to 0683-4715 R:FXD COMP 470 ohm 5% 1/4W.

Table 7-3:
Change A6CR13 to 1902-3193 Diode, Sil 13.3V

Change A6R3 to 0683-4315 R:FXD COMP 430 ohm 5% 1/4W.

Table 6-1:
Delete CR1 and CR2.

Table 7-2. A4-05216-6011 Main Board Parts

Reference Designation	Part No.	Description #
A4	05216-6011	MAIN BOARD ASSY
	05216-2011	BOARD:BLANK PC
A4C1	0150-0042	C:FXD TI 4.7 PF 5% 500VDCW
A4C2	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW
A4C3		NOT ASSIGNED
A4C4	0160-2209	C:FXD MICA 360 PF 5%
A4C5		NOT ASSIGNED
A4C6	0180-0229	C:FXD ELECT 33 UF 10% 10VDCW
A4C7	0180-0291	C:FXD ELECT 1 UF 10% 35VDCW
A4C8	0160-2257	C:FXD CER 10 PF 5% 500VDCW
A4C9	0160-2250	C:FXD CER 5.1 PF 500VDCW
A4C10	0160-2257	C:FXD CER 10 PF 5% 500VDCW
A4C11	0180-0291	C:FXD ELECT 1 UF 10% 35VDCW
A4CR1	1901-0040	DIODE:SILICON 30MA 30WV
A4CR2	1901-0040	DIODE:SILICON 30MA 30WV
A4CR3	1901-0040	DIODE:SILICON 30MA 30WV
A4CR4	1901-0040	DIODE:SILICON 30MA 30WV
A4CR5	1901-0040	DIODE:SILICON 30MA 30WV
A4CR6	1910-0016	DIODE:GERMANIUM 100MA
A4CR7	1910-0016	DIODE:GERMANIUM 100MA
A4CR8	1910-0016	DIODE:GERMANIUM 100MA
A4CR9	1910-0016	DIODE:GERMANIUM 100MA
A4CR10		NOT ASSIGNED
A4CR11	1910-0016	DIODE:GERMANIUM 100MA
A4CR12	1910-0016	DIODE:GERMANIUM 100MA
A4CR13	1901-0040	DIODE:SILICON 30MA 30WV
A4CR14	1901-0040	DIODE:SILICON 30MA 30WV
A4CR15	1901-0040	DIODE:SILICON 30MA 30WV
A4CR16	1910-0016	DIODE:GERMANIUM 100MA
A4CR17	1910-0016	DIODE:GERMANIUM 100MA
A4CR18	1910-0016	DIODE:GERMANIUM 100MA
A4CR19	1910-0016	DIODE:GERMANIUM 100MA
A4CR20	1910-0016	DIODE:GERMANIUM 100MA
A4CR21	1901-0040	DIODE:SILICON 30MA 30WV
A4CR22	1910-0016	DIODE:GERMANIUM 100MA
A4CR23	1901-0040	DIODE:SILICON 30MA 30WV
A4CR24	1901-0040	DIODE:SILICON 30MA 30WV
A4CR25	1901-0025	DIODE:SILICON 100WV 100MA
A4CR26	1902-0197	DIODE:BREAKDOWN 82.5V
A4CR27	1902-0197	DIODE:BREAKDOWN 82.5V
A4CR28	1901-0025	DIODE:SILICON 100WV 100MA
A4CR29	1910-0016	DIODE:GERMANIUM 100MA
A4CR30	1910-0016	DIODE:GERMANIUM 100MA
A4CR31	1901-0025	DIODE:SILICON 100WV 100MA
A4CR32	1901-0025	DIODE:SILICON 100WV 100MA
A4DS1	1970-0025	ELECTRON TUBE
A4DS2	1970-0025	ELECTRON TUBE
A4DS3	1970-0025	ELECTRON TUBE
A4DS4	1970-0025	ELECTRON TUBE
A4DS5	1970-0025	ELECTRON TUBE
A4DS6	1970-0025	ELECTRON TUBE
A4DS7	1970-0025	ELECTRON TUBE
A4IC1	1820-0098	CIRCUIT:HP
A4IC2	1820-0098	CIRCUIT:HP
A4IC3	1820-0098	CIRCUIT:HP
A4IC4	1820-0098	CIRCUIT:HP
A4IC5		NOT ASSIGNED
A4IC6		NOT ASSIGNED
A4IC7		NOT ASSIGNED
A4IC8	1820-0054	CIRCUIT T-I SN 7400 N
A4IC9	1820-0054	CIRCUIT T-I SN 7400 N
A4IC10	1820-0072	CIRCUIT T-I SN 7450 N
A4IC11	1820-0054	CIRCUIT T-I SN 7400 N
A4IC12	1820-0075	CIRCUIT T-I SN 7473 N
A4IC13	1820-0065	CIRCUIT: T-I SN 7470
A4IC14	1820-0092	CIRCUIT:HP
A4IC15	1820-0090	CIRCUIT:HP
A4IC16	1820-0093	CIRCUIT:HP
A4IC17	1820-0092	CIRCUIT:HP
A4IC18	1820-0090	CIRCUIT:HP
A4IC19	1820-0093	CIRCUIT:HP
A4IC20	1820-0092	CIRCUIT:HP
A4IC21	1820-0090	CIRCUIT:HP
A4IC22	1820-0093	CIRCUIT:HP
A4IC23	1820-0092	CIRCUIT:HP
A4IC24	1820-0090	CIRCUIT:HP
A4IC25	1820-0093	CIRCUIT:HP
A4IC26	1820-0092	CIRCUIT:HP
A4IC27	1820-0090	CIRCUIT:HP
A4IC28	1820-0093	CIRCUIT:HP
A4IC29	1820-0092	CIRCUIT:HP
A4IC30	1820-0090	CIRCUIT:HP
A4IC31	1820-0093	CIRCUIT:HP
A4IC32	1820-0092	CIRCUIT:HP
A4IC33	1820-0090	CIRCUIT:HP
A4IC34	1820-0079	CIRCUIT:HP
A4IC35	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q1	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q2	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q3	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q4	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q5		

See introduction to this section for ordering information

See list of abbreviations in introduction to this section

Table 7-2. A4-05216-6011 Main Board Parts (Continued)

Reference Designation	Stock No.	Description #
A4Q6	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q7	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q8	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q9	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q10	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q11	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q12	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q13	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q14	1854-0009	TRANSISTOR:SILICON NPN 2N709
A4Q15	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A4Q16	1854-0232	TRANSISTOR:SILICON NPN
A4R1		NOT ASSIGNED
A4R2		NOT ASSIGNED
A4R3		NOT ASSIGNED
A4R4		NOT ASSIGNED
A4R5		NOT ASSIGNED
A4R6		NOT ASSIGNED
A4R7	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R8	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R9	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R10		NOT ASSIGNED
A4R11	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W
A4R12		NOT ASSIGNED
A4R13	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R14	0683-4325	R:FXD COMP 4300 OHM 5% 1/4W
A4R15	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R16	0683-5115	R:FXD COMP 510 OHM 5% 1/4W
A4R17	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R18	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R19	0683-1135	R:FXD COMP 11K OHM 5% 1/4W
A4R20	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R21	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R22	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R23	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R24	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W
A4R25	0683-4715	R:FXD COMP 470 OHM 5% 1/4W
A4R26	0683-1535	R:FXD COMP 15K OHM 5% 1/4W
A4R27	0683-1535	R:FXD COMP 15K OHM 5% 1/4W
A4R28	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R29	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R30	0683-4715	R:FXD COMP 470 OHM 5% 1/4W
A4R31	0683-2735	R:FXD COMP 27K OHM 5% 1/4W
A4R32	0683-4715	R:FXD COMP 470 OHM 5% 1/4W
A4R33	0683-4715	R:FXD COMP 470 OHM 5% 1/4W
A4R34	0683-4325	R:FXD COMP 4300 OHM 5% 1/4W
A4R35	0683-5115	R:FXD COMP 510 OHM 5% 1/4W
A4R36	0683-1035	R:FXD COMP 10K OHM 5% 1/4W

See list of abbreviations in introduction to this section

Reference Designation	Stock No.	Description #
A4R37	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R38	0683-5625	R:FXD COMP 5600 OHM 5% 1/4W
A4R39	0683-5115	R:FXD COMP 510 OHM 5% 1/4W
A4R40	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R41	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R42	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R43	0683-4325	R:FXD COMP 4300 OHM 5% 1/4W
A4R44	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R45	0683-1035	R:FXD COMP 10K OHM 5% 1/4W
A4R46	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A4R47	0683-5115	R:FXD COMP 510 OHM 5% 1/4W
A4R48	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W
A4R49	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R50	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R51	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R52	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R53	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R54	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R55	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R56	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R57	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R58	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R59	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R60	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R61	0675-1021	R:FXD CARBON 1K OHM 10% 1/8W
A4R62	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R63	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R64	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R65	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R66	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R67	0675-1021	R:FXD CARBON 1K OHM 10% 1/8W
A4R68	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R69	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R70	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R71	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R72	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R73	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R74	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R75	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R76	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R77	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R78	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R79	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R80	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R81	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R82	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R83	0698-6123	R:FXD COMP 20K OHM 5% 1/8W
A4R84	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R85	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W
A4R86	0683-5125	R:FXD COMP 5100 OHM 5% 1/4W

See list of abbreviations in introduction to this section

Table 7-3. A6-05216-6002 Power Supply Parts

Reference Designation	Part No.	Description #
A6	05216-6002	POWER SUPPLY ASSY
	05126-2002	BOARD:BLANK PC
	05216-4006	HOLDER:POWER SUPPLY
A6C1	0180-2102	C:FXD ELECT 700 UF +75-10% 25VDCW
A6C2	0180-2101	C:FXD ELECT 4000 UF +75-10% 15VDCW
	1400-0040	CLIP:CAPACITOR
A6C3	0180-2103	C:FXD ELECT 500 UF +75-10% 10VDCW
	1400-0042	CLIP:CAPACITOR
A6C4	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW
A6C5	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW
A6C6	0180-0032	C:FXD ELECT 10 UF +75-10% 12VDCW
A6C7	0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW
A6C8	0160-0147	C:FXD MICA 2500 PF 2% 300VDCW
A6CR1	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP
A6CR2	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP
A6CR3	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP
A6CR4	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP
A6CR5	1901-0049	DIODE:SILICON 50PIV
A6CR6	1901-0049	DIODE:SILICON 50PIV
A6CR7	1901-0049	DIODE:SILICON 50PIV
A6CR8	1901-0049	DIODE:SILICON 50PIV
A6CR9	1901-0200	DIODE:SILICON 100 PIV 3A
A6CR10	1901-0200	DIODE:SILICON 100 PIV 3A
A6CR11	1901-0200	DIODE:SILICON 100 PIV 3A
A6CR12	1901-0200	DIODE:SILICON 100 PIV 3A
A6CR13	1902-3036	DIODE BREAKDOWN:SILICON 3.16V
A6CR14	1902-3036	DIODE BREAKDOWN:SILICON 3.16V
A6CR15	1902-0040	DIODE BREAKDOWN:14.0V 5%
A6CR16	1902-3036	DIODE BREAKDOWN:SILICON 3.16V
A6CR17	1902-3059	DIODE BREAKDOWN:SILICON 3.83V 5%
A6CR18	1902-0673	DIODE BREAKDOWN:6.04V 2%
A6CR19	1902-0673	DIODE BREAKDOWN:6.04V 2%
A6Q1	1854-0039	TRANSISTOR:SILICON 2N3053
A6Q2	1854-0232	TRANSISTOR:SILICON NPN
	1205-0061	HEAT DISSIPATOR:SEMICONDUCTOR
A6Q3	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A6Q4	1854-0071	TRANSISTOR:SILICON NPN 2N3391
A6R1	2100-1758	R:VAR WW 1K OHM 10% LIN 1/2W
A6R2	0686-5135	R:FXD COMP 51K OHM 5% 1/2W
A6R3	0683-2215	R:FXD COMP 220 OHM 5% 1/4W
A6R4	0686-8235	R:FXD COMP 82K OHM 5% 1/2W
A6R5	0686-1005	R:FXD COMP 10 OHM 5% 1/2W
A6R6	0683-1315	R:FXD COMP 130 OHM 5% 1/4W
A6R7	2100-1756	R:VAR WW 200 OHM 10% LIN 1/2W
A6R8	0683-3615	R:FXD COMP 360 OHM 5% 1/4W
A6R9	0683-1315	R:FXD COMP 130 OHM 5% 1/4W
A6RT1	0839-0021	THERMISTOR:DISC 500 OHM 10%

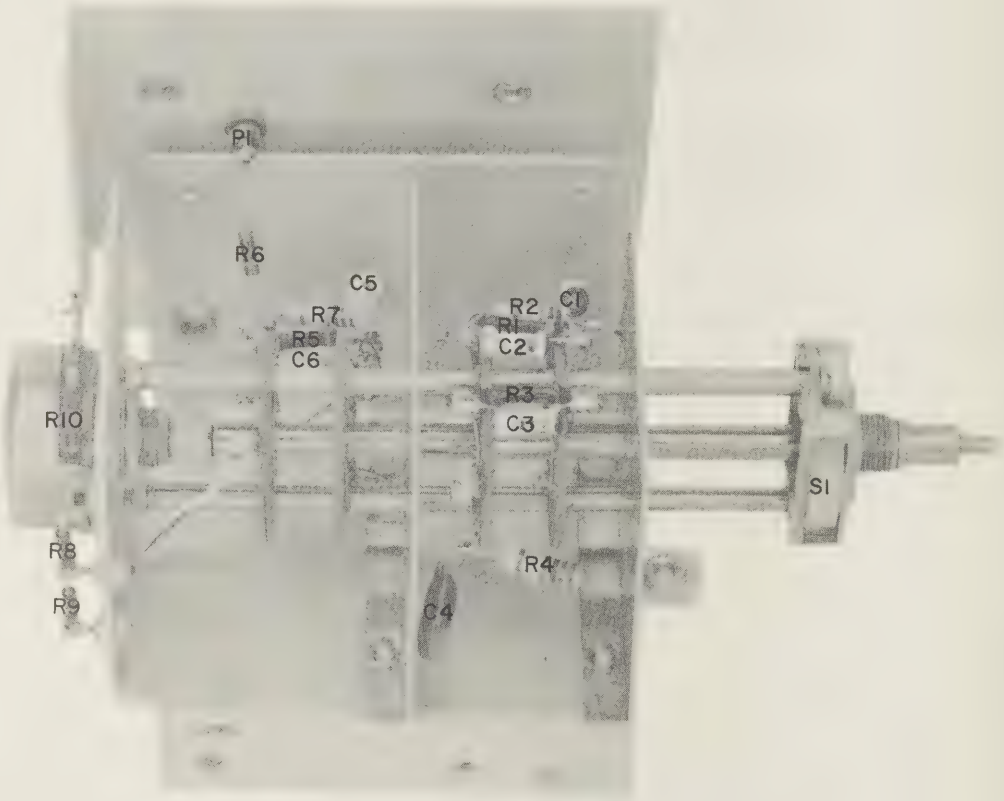
See introduction to this section for ordering information

Table 7-4. A3-05216-6006 Oscillator Parts

Reference Designation	Part No.	Description #
A3	05216-6006	OSCILLATOR ASSY
	05216-2005	BOARD:BLANK PC
A3C1	0180-0291	C:FXD ELECT 1 UF 10% 35VDCW
A3C2	0180-0291	C:FXD ELECT 1 UF 10% 35VDCW
A3C3	0160-2207	C:FXD MICA 300 PF 5%
A3C4	0160-2201	C:FXD MICA 51 PF 5%
A3C5	0121-0178	C:VAR CER 15-60 PF
A3C6	0121-0060	C:VAR CER 2-8 PF
A3C7	0160-2201	C:FXD MICA 51 PF 5%
A3C8	0160-2211	C:FXD MICA 510 PF 5% 300VDCW
A3C9	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW
A3C10	0160-0945	C:FXD MICA 910 PF 5%
A3L1	9140-0129	COIL:FXD RF 220 UH
A3Q1	1854-0092	TRANSISTOR:SILICON NPN
A3Q2	1854-0009	TRANSISTOR:SILICON NPN 2N709
A3R1	0683-1015	R:FXD COMP 100 OHM 5% 1/4W
A3R2	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W
A3R3	0683-4325	R:FXD COMP 4300 OHM 5% 1/4W
A3R4	0683-6225	R:FXD COMP 6200 OHM 5% 1/4W
A3R5	0683-1015	R:FXD COMP 100 OHM 5% 1/4W
A3R6	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A3R7	0683-2025	R:FXD COMP 2000 OHM 5% 1/4W
A3R8	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W
A3XY1	1200-0159	CRYSTAL HOLDER
A3Y1	0410-0130	CRYSTAL:QUARTZ 10 MHZ

See introduction to this section for ordering information

Figure 7-1. A1 Input Attenuator (Component Locator) (Sheet 1 of 2)



A1

Figure 7-1. A1 Input Attenuator (Schematic) (Sheet 2 of 2)

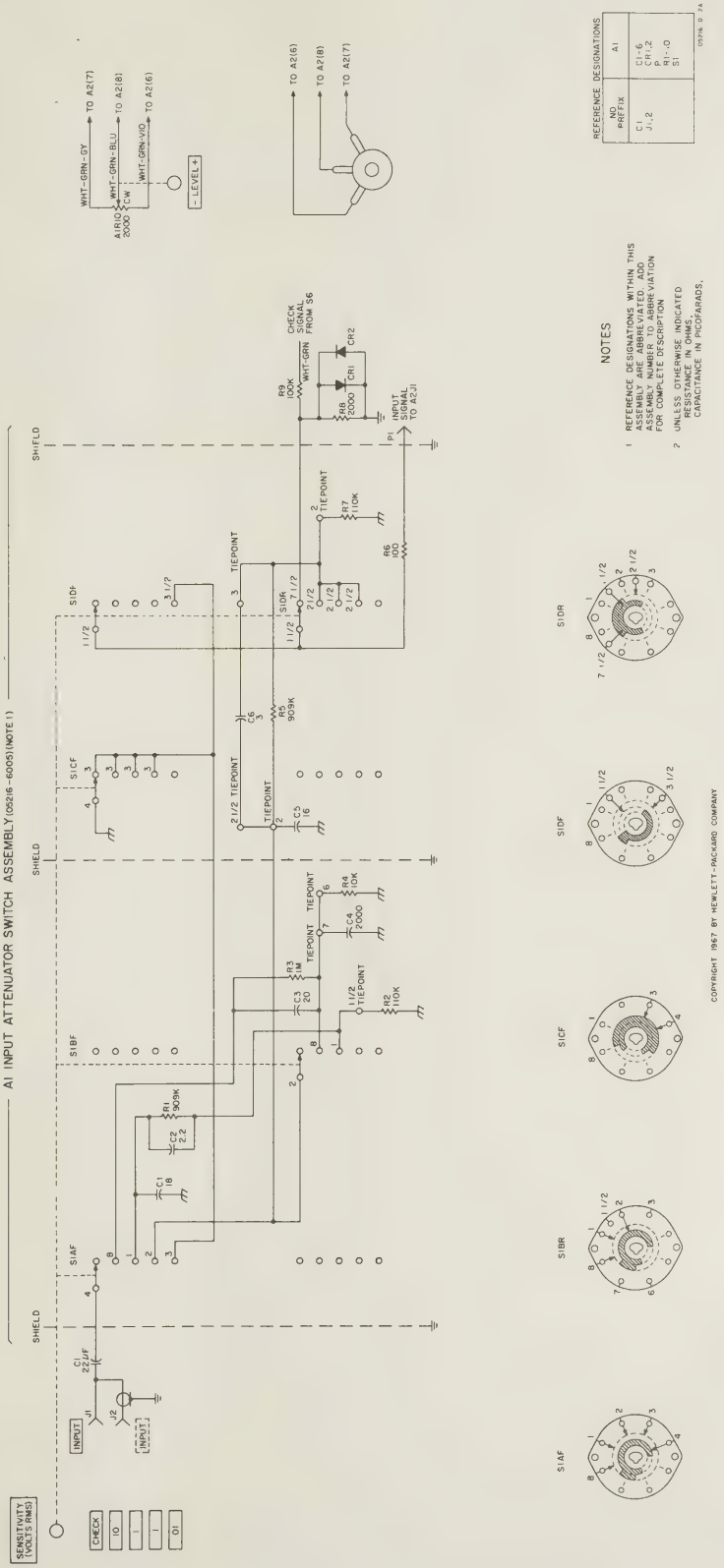


Figure 7-2. A4 Main Board (Schematic) (Sheet 1 of 3)

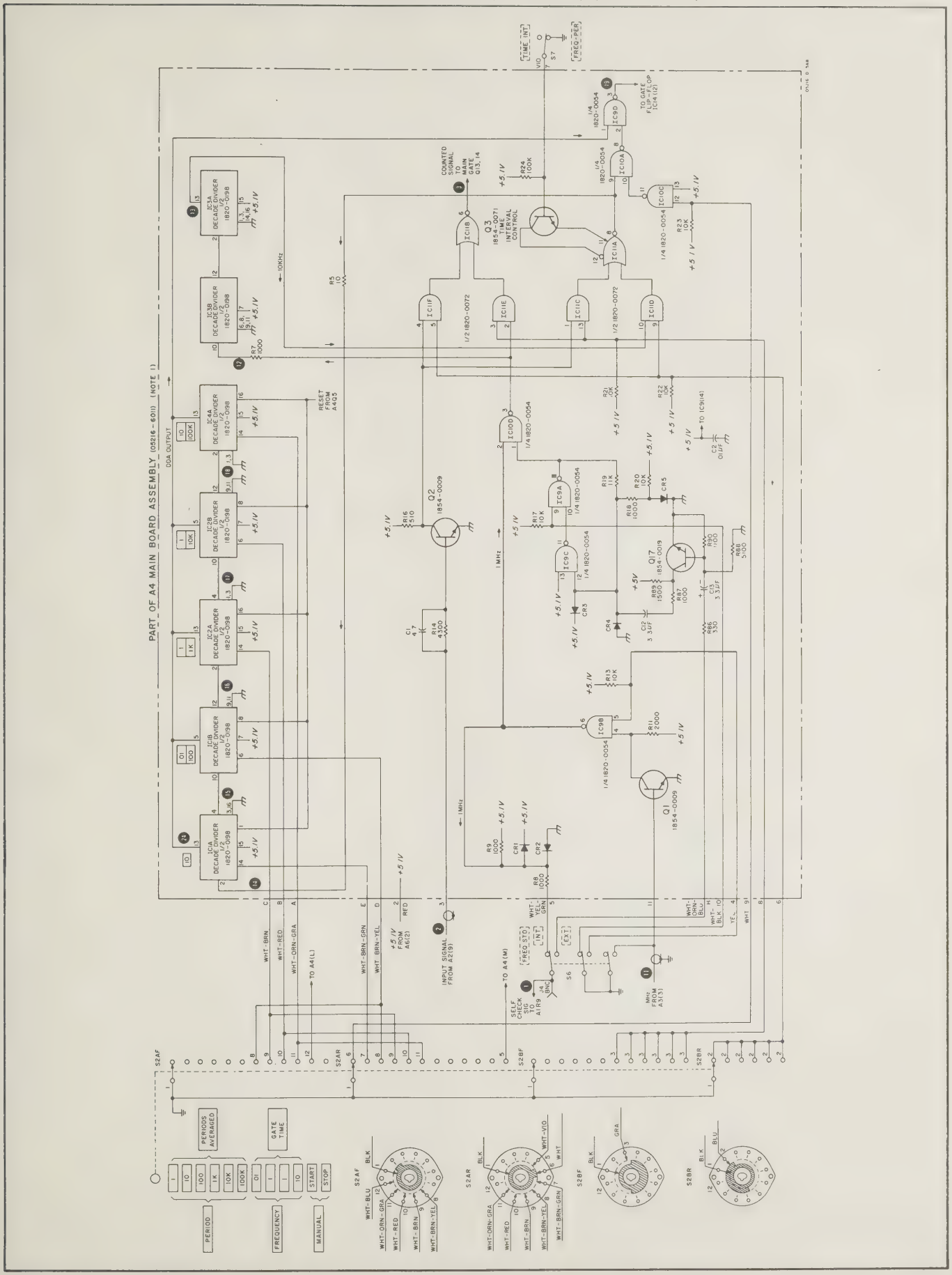


Figure 7-3. A4 Main Board (Schematic) (Sheet 2 of 3)

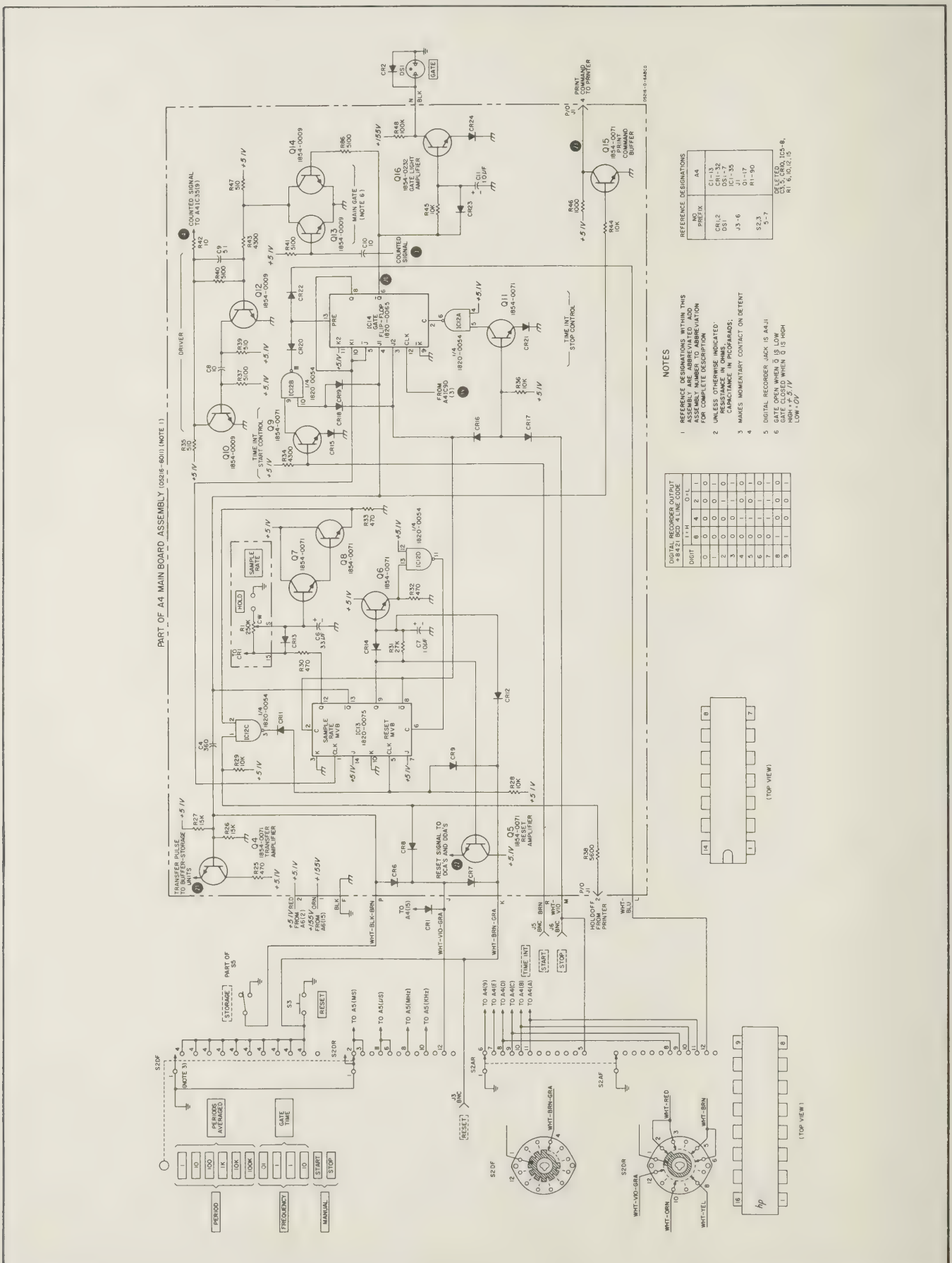


Figure 7-4. A4 Main Board (Schematic) (Sheet 3 of 3)

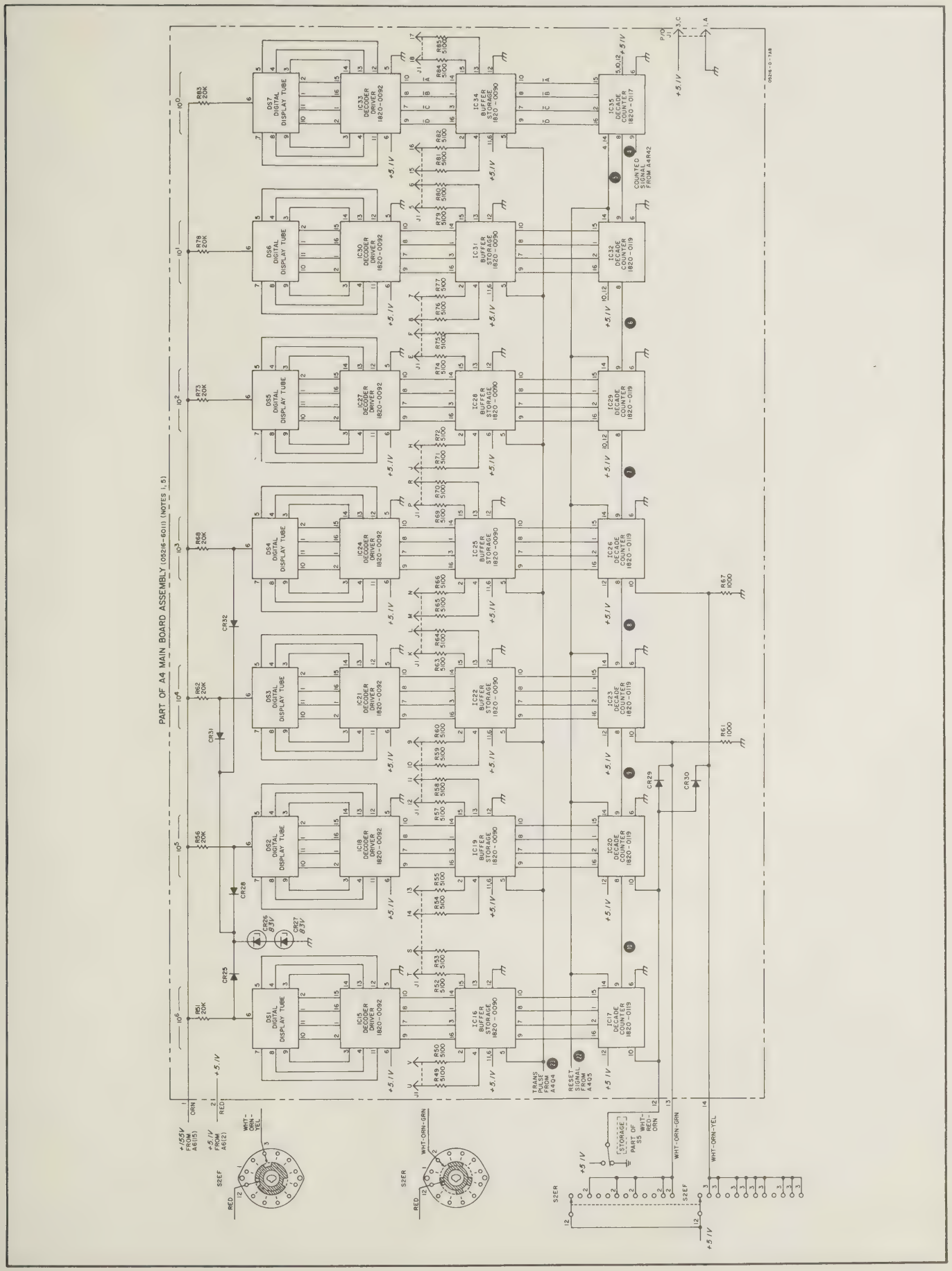


Figure 7-5. A6 Power Supply (Component Locator) (Sheet 1 of 2)

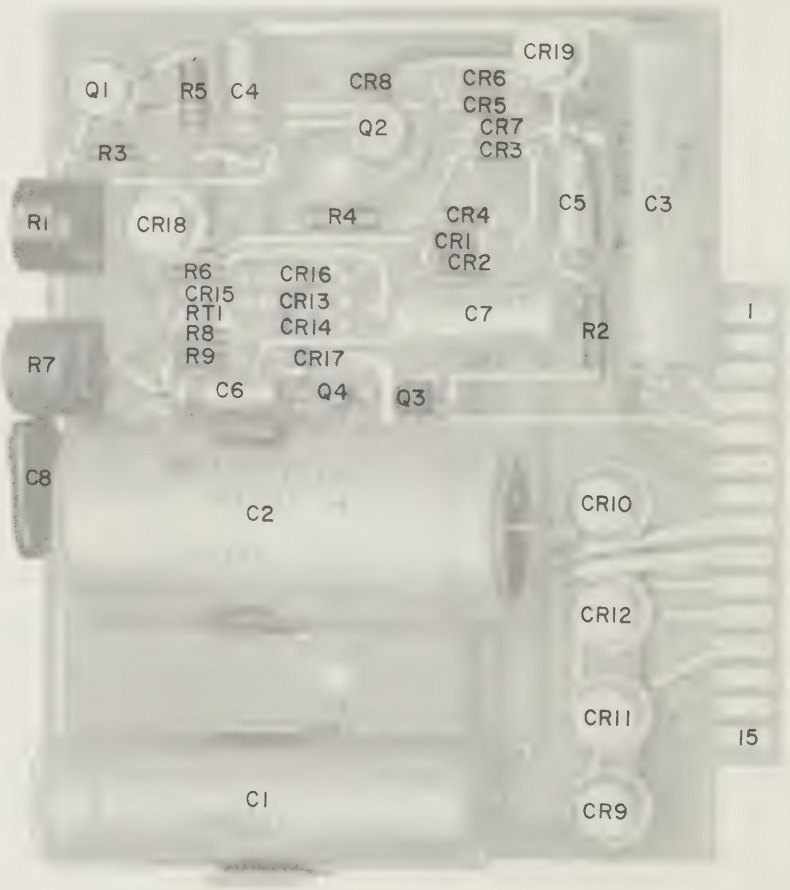


Figure 7-5. A6 Power Supply (Schematic) (Sheet 2 of 2)

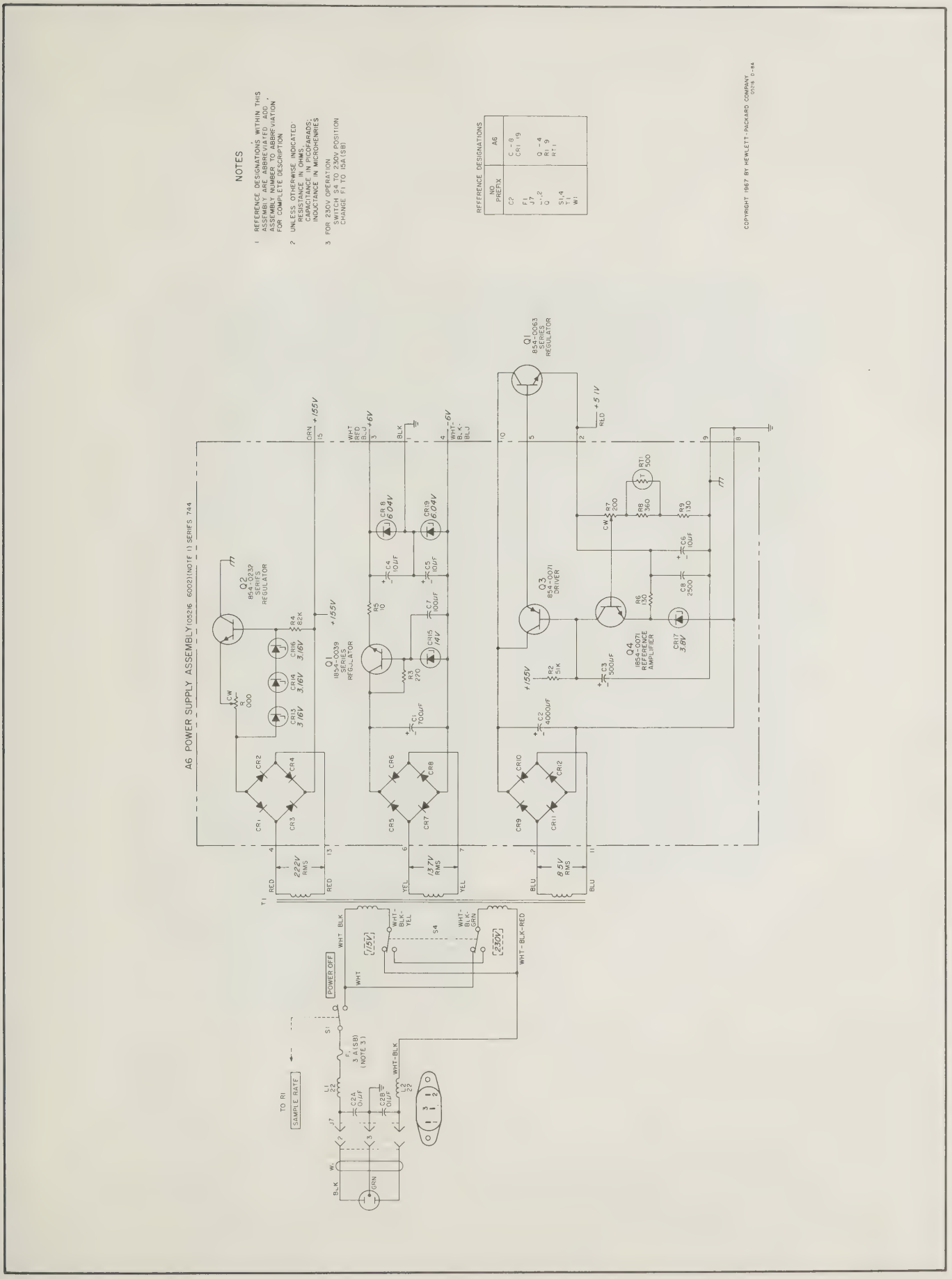


Figure 7-6. A4 Main Board (Component Locator)

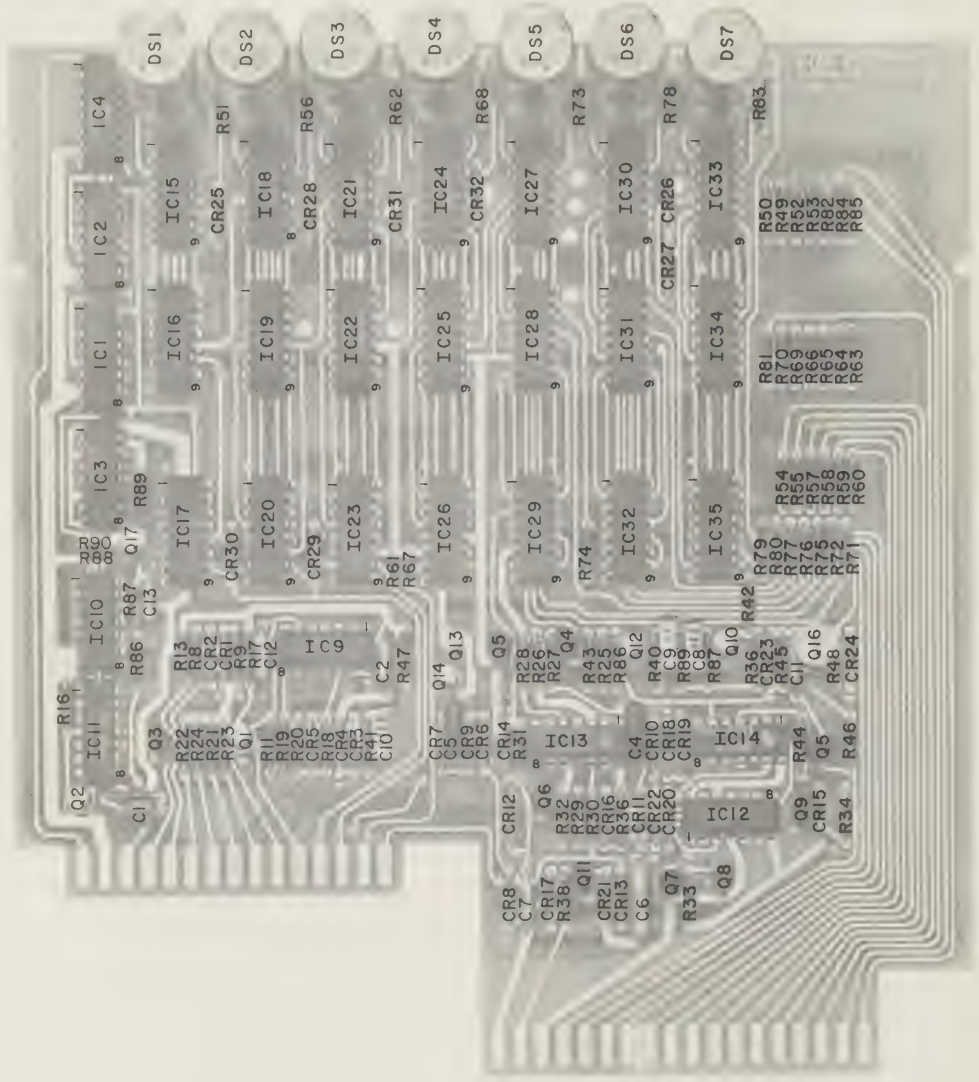


Figure 7-7. A4 Main Board (Schematic) (Sheet 2 of 3)

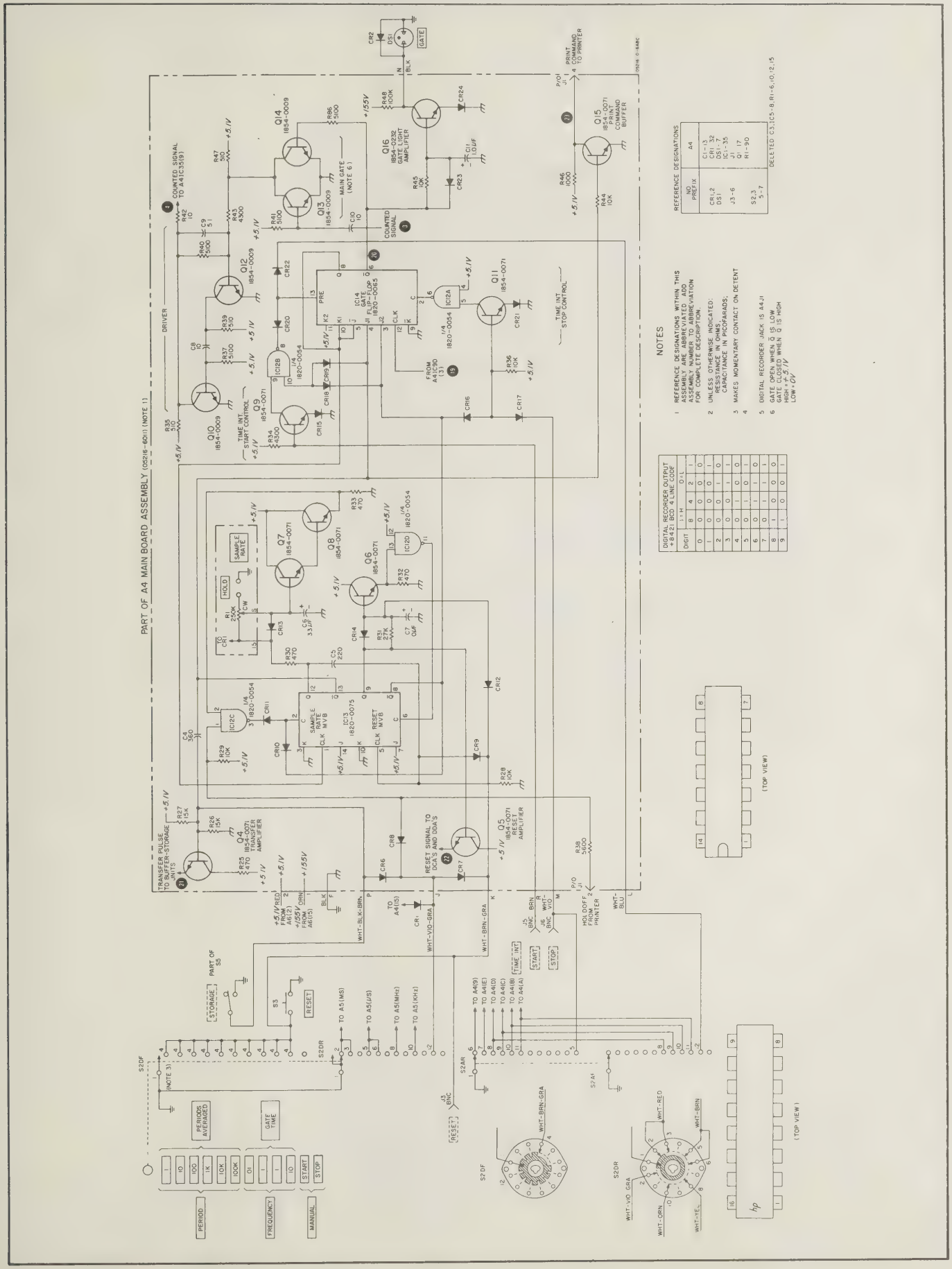
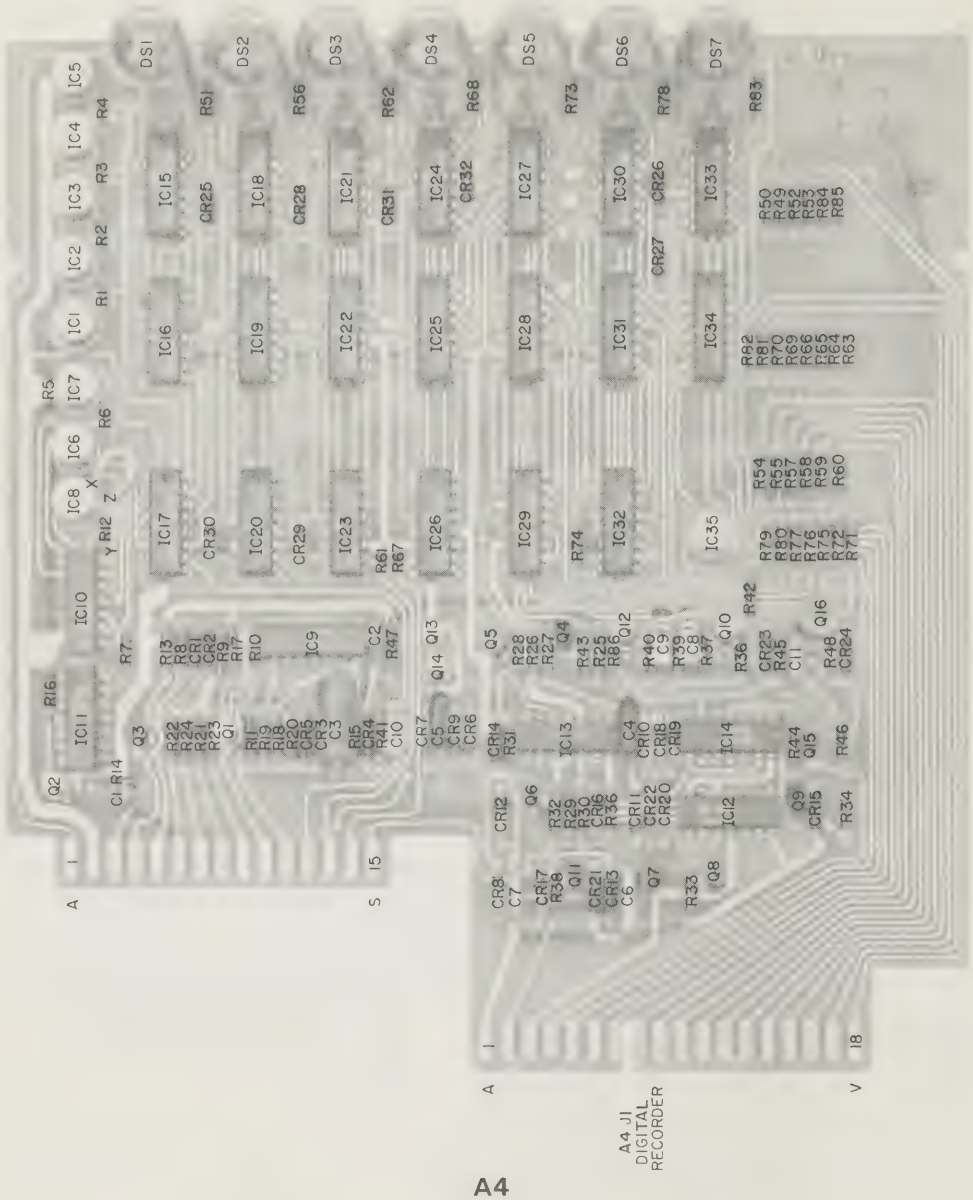
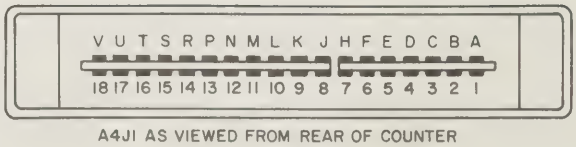


Figure 7-8. A4 Main Board (Component Locator)





A4J1 AS VIEWED FROM REAR OF COUNTER

Figure 7-9. A4 Main Board (Schematic) (Sheet 1 of 3)

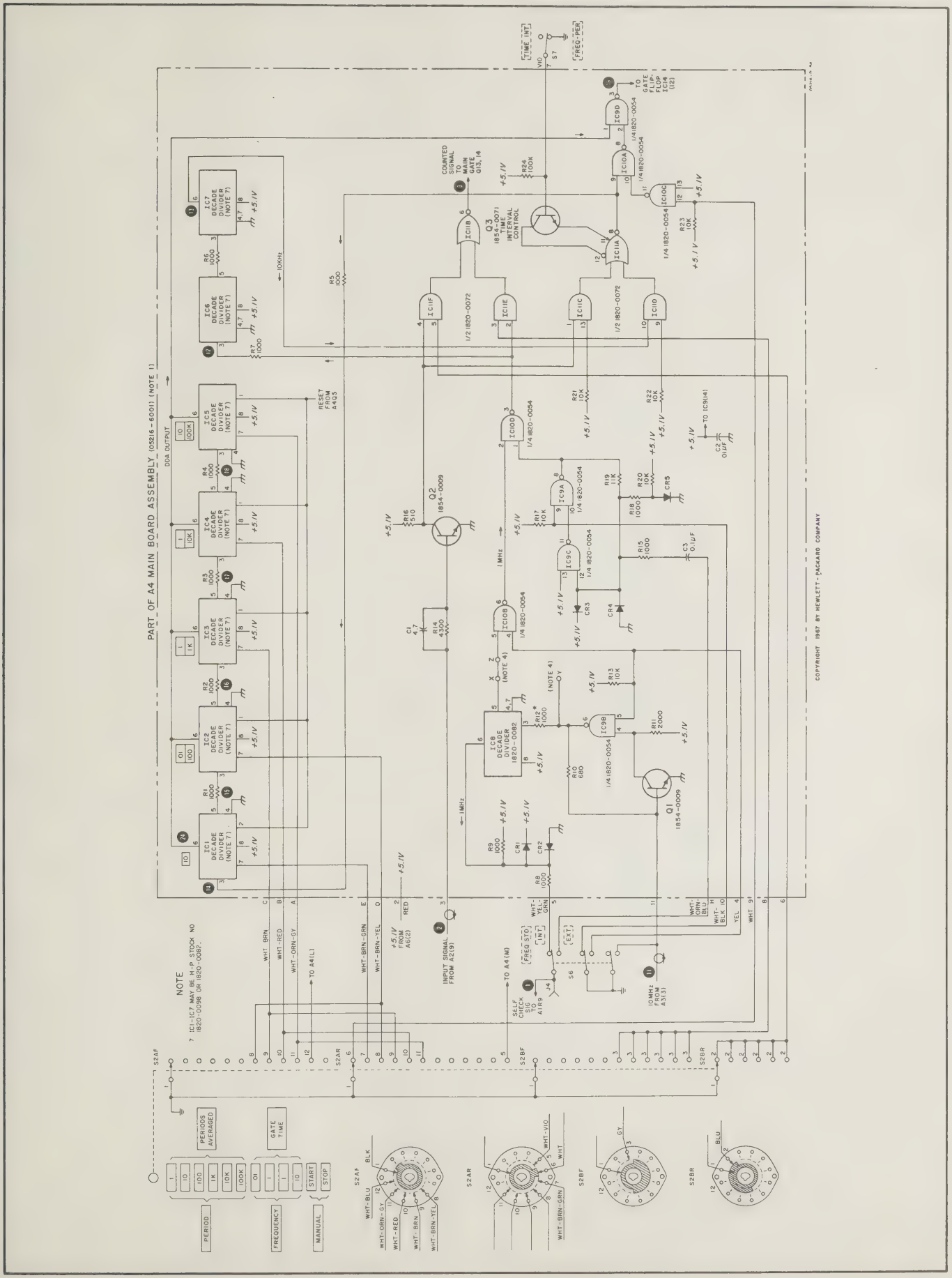


Figure 7-10. A4 Main Board (Schematic) (Sheet 2 of 3)

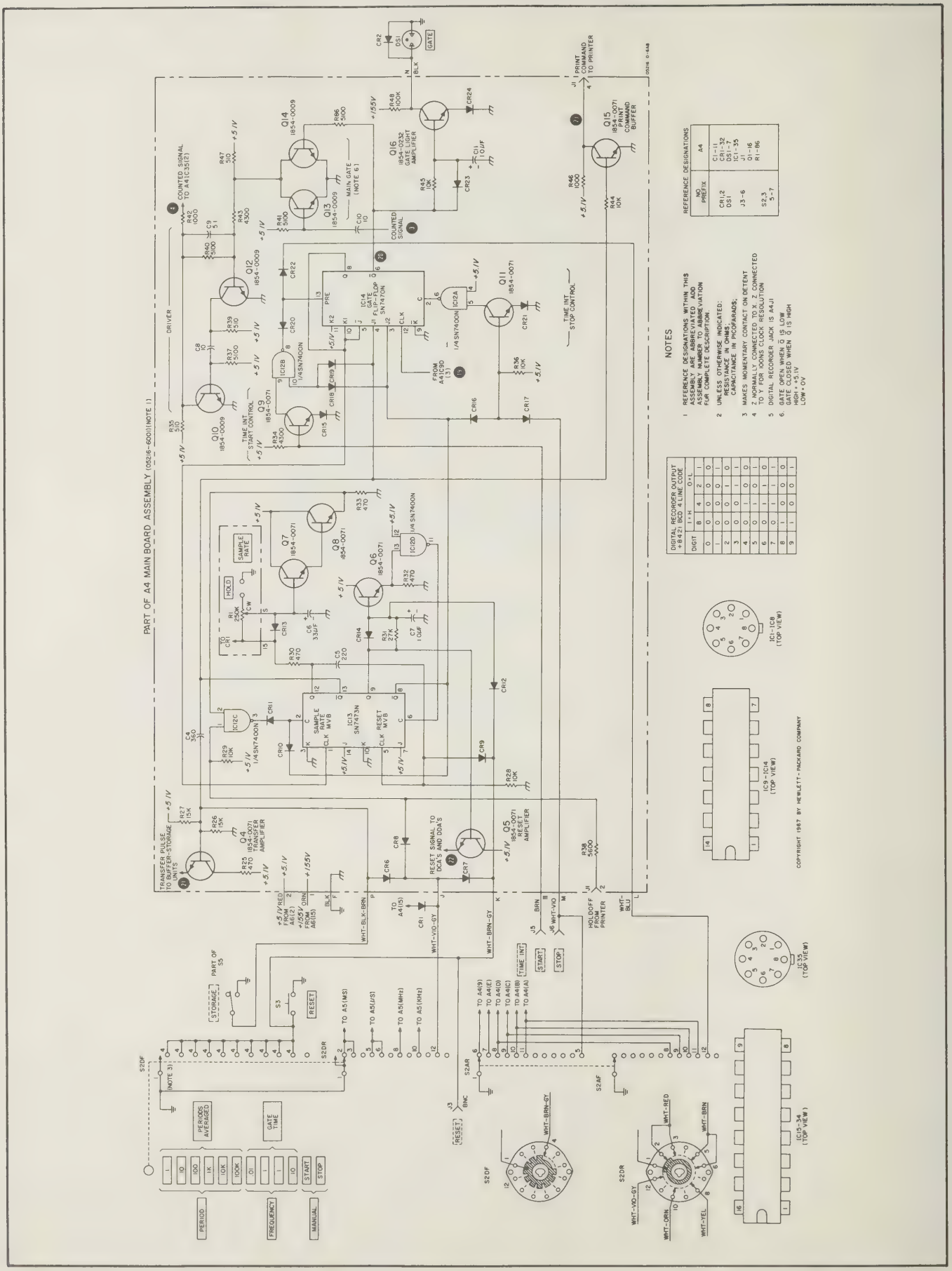


Figure 7-11. A4 Main Board (Schematic) (Sheet 3 of 3)

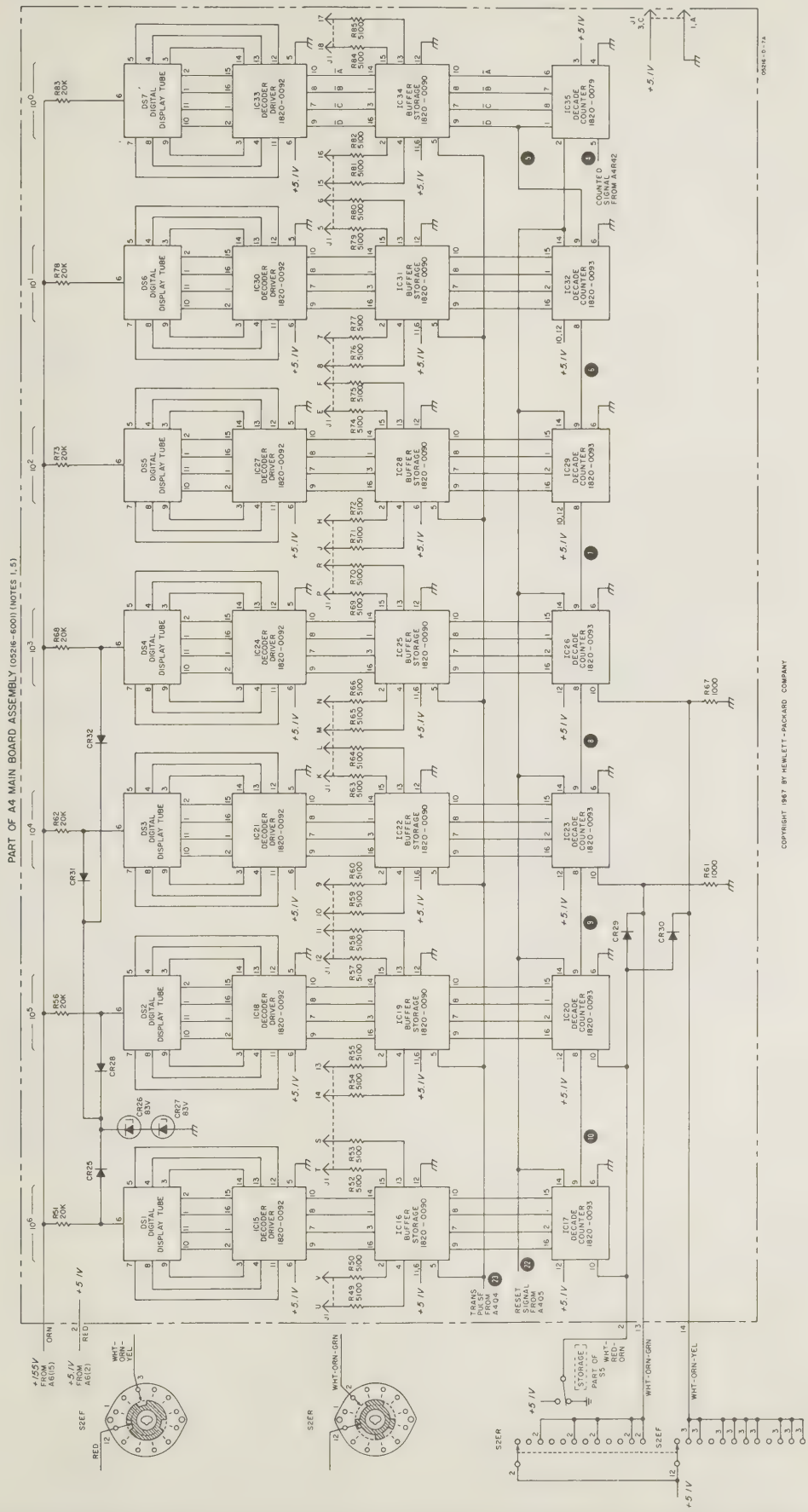
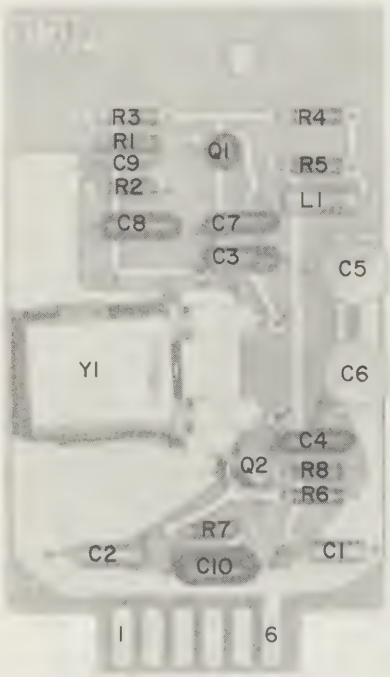


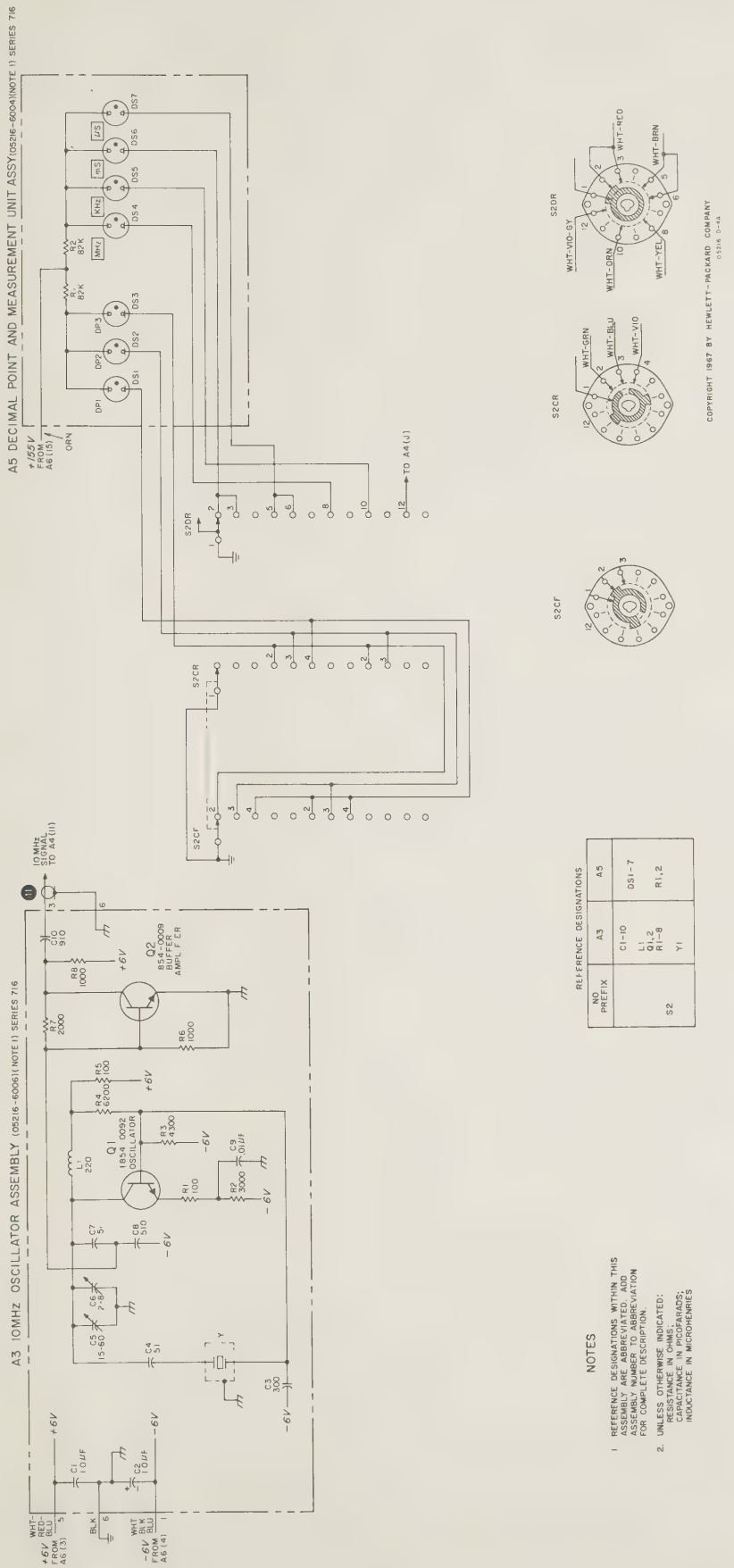
Figure 7-12. A3 10 MHz Oscillator, A5 Decimal Point and Measurement Unit (Component Locator) (Sheet 1 of 2)



A3

A5

Figure 7-13. A3 10 MHz Oscillator, A5 Decimal Point and Measurement Unit (Schematic) (Sheet 2 of 2)



SECTION VIII

CIRCUIT DIAGRAMS

8-1. INTRODUCTION

8-2. This section includes the following:

a. General Notes for Schematic Diagrams (Figure 8-1).

b. Functional flow diagrams for the gating section of Main Board Assembly A4 (Figures 8-2 through 8-5).

c. Schematic Diagrams and Component Location illustrations of Model 5216A printed circuit assemblies in the order of their assembly designation (A1 through A6, Figures 8-6 through 8-11). These figures may also include waveforms and voltages. Top view of integrated circuits is shown with pin numbers for identification.

8-3. The Flow Diagrams or any schematic diagram, when unfolded, can be used with any other part of this manual, or with the manual closed.

8-4. DC Voltages are measured with a HP Model 412A DC Voltmeter. Typical voltages are shown.

8-5. Waveforms taken with a HP Model 175A Oscilloscope with the HP 1755A Dual Trace Amplifier plug-in installed. Oscilloscope vertical amplifier bandwidth is at least 20 MHz when used with 10:1 divider probe HP 10001A.

8-6. Shaded areas on the schematic diagrams indicate printed circuit board assemblies. All components within the shaded areas are mounted on the boards.

Figure 8-1. Schematic Diagram Notes

SYMBOLS

FRONT PANEL

REAR PANEL

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

CONDUCTING ELEMENT

CW — WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

POWER LINE GROUND

CIRCUIT COMMON GROUND

8 — TEST POINT

"AND" GATE

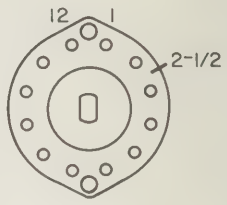
INHIBIT GATE

"OR" GATE

WAVEFORMS SHOWN ARE TYPICAL

SWITCH DESIGNATIONS

A3S1BR(2-1/2)

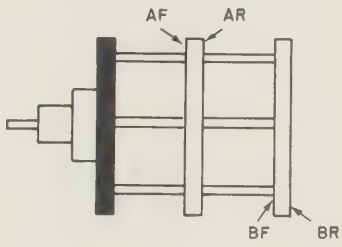


A3S1 — SWITCH S1 WITHIN ASSEMBLY A3

B — 2ND WAFER FROM FRONT (A=1ST, ETC)

R — REAR OF WAFER (F=FRONT)

(2-1/2) — TERMINAL LOCATION ($2\frac{1}{2}$) (VIEWED FROM FRONT)



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

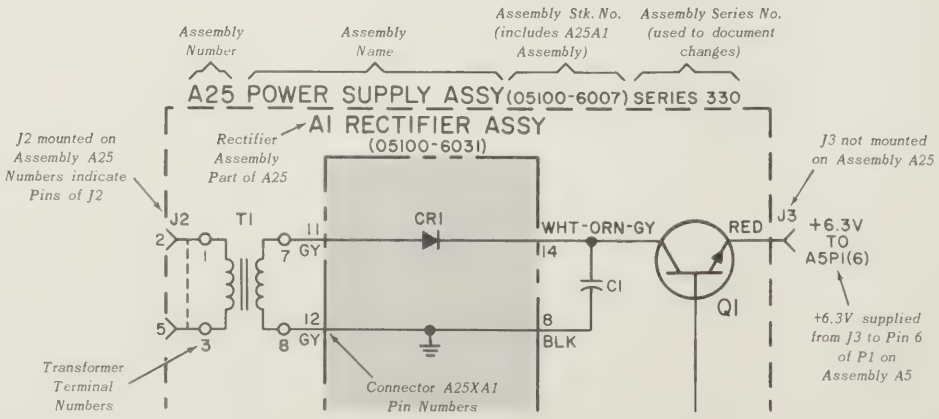
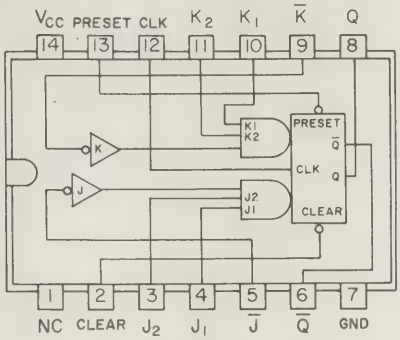


Figure 8-2. Integrated Circuit Diagram



1820-0065(SN7470N)
J-K FLIP-FLOP

POSITIVE LOGIC

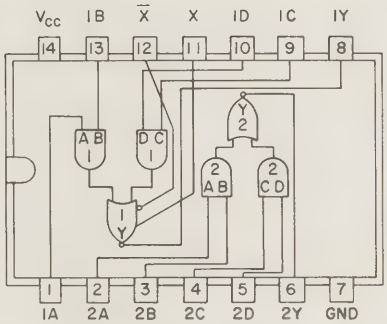
LOW INPUT TO PRESET SETS Q TO LOGICAL 1
LOW INPUT TO CLEAR SET Q TO LOGICAL 0

TRUTH TABLE

t_n		t_{n+1}
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q_n}$

NOTE:
CLOCK MUST BE AT LOGICAL 0 PRIOR TO THE APPLICATION OF PRESET OR CLEAR FUNCTIONS.

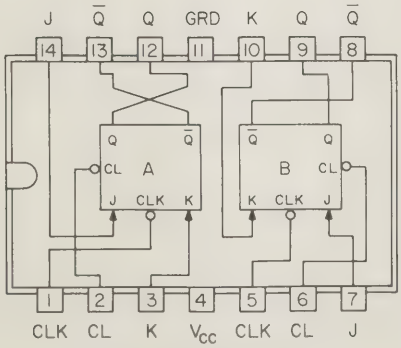
NOTES:
1. J=J1, J2, J̄
2. K=K1, K2, K̄
3. t_n= BIT TIME BEFORE CLOCK PULSE
4. t_{n+1} = BIT TIME AFTER CLOCK PULSE



1820-0072
DUAL 2-WIDE 2-INPUT AND-OR-INVERT GATES (SN7450N)

POSITIVE LOGIC

Y= (AB) + (CD)+X
X= ABCD from SN7460N



1820-0075(SN7473N)
DUAL J-K MASTER-SLAVE FLIP-FLOP

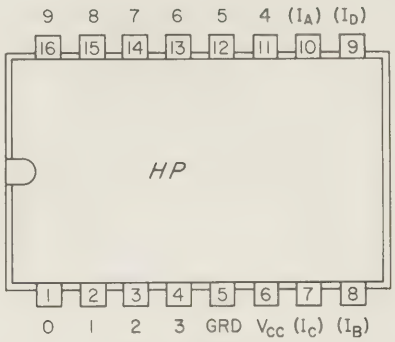
TRUTH TABLE
(EACH FLIP-FLOP)

t_n		t_{n+1}
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q_n}$

NOTES

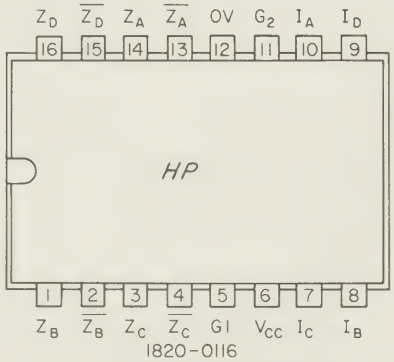
1. t_n = BIT TIME BEFORE CLOCK PULSE
2. t_{n+1} = BIT TIME AFTER CLOCK PULSE
3. POSITIVE LOGIC:
   LOW INPUT TO CLEAR SETS Q TO LOGICAL 0 REGARDLESS OF CLOCK STATE

Figure 8-2. Integrated Circuit Diagram (Continued)



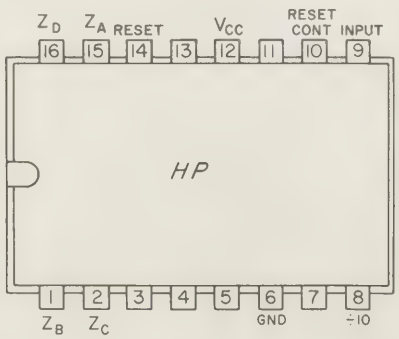
1820-0092
DRIVER
NEGATIVE LOGIC

I_A(1)	I_B(2)	I_C(4)	I_B(8)	"ON" OUTPUT
H	H	H	H	0
L	H	H	H	1
H	L	H	H	2
L	L	H	H	3
H	H	L	H	4
L	H	L	H	5
H	L	L	H	6
L	L	L	H	7
H	H	H	L	8
L	H	H	L	9
BCD 10-15				NONE



1820-0116
4-BIT BUFFER STORAGE
(POSITIVE LOGIC)

Digit	Input Pin Number D (9)	C (7)	B (8)	A (10)	Output Pin Number (to decoder) D (16)	C (3)	B (1)	A (14)	Output Pin Number (to J8) D (15)	C (4)	B (2)	A (13)
0	H	H	H	H	H	H	H	H	L	L	L	L
1	H	H	H	L	H	H	H	L	L	L	L	H
2	H	H	L	H	H	H	L	H	L	L	H	L
3	H	H	L	L	H	H	L	L	L	L	H	H
4	H	L	H	H	H	L	H	H	L	H	L	L
5	H	L	H	L	H	L	H	L	L	H	L	H
6	H	L	L	H	H	L	L	H	L	H	H	L
7	H	L	L	L	H	L	L	L	L	H	H	H
8	L	H	H	H	L	H	H	H	H	L	L	L
9	L	H	H	L	L	H	H	L	H	L	L	H
	H = High (> +3.0V) L = Low (< +0.5V)				H = High (> +2.1V) L = Low (< +0.4V)				H = High (> 4.6V) L = Low (< +0.4V)			



1 1820-0117,0119,0232
BLANKING DECADE COUNTER
NEGATIVE LOGIC 1= LOW
0= HIGH

TRUTH TABLE

INPUT PULSE	OUTPUT A	B	C	D
0	H	H	H	H
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
RESET CONTROL HIGH & RESET PULSE	H	H	H	H
RESET CONTROL LOW & RESET PULSE	L	L	L	L

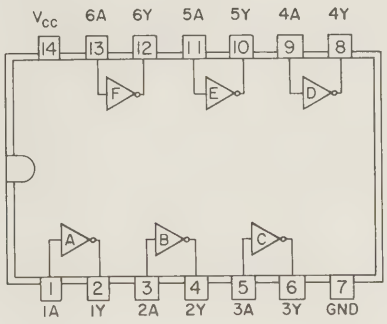
POSITIVE PULSE APPLIED TO RESET WILL:

A. RESET A,B,C & D TO LOW IF RESET CONTROL IS LOW.

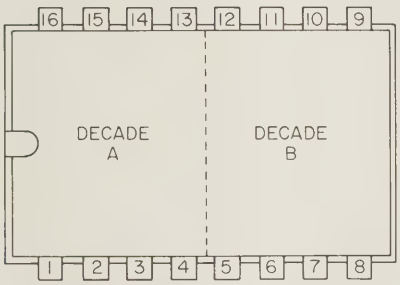
B. RESET A,B,C & D TO HIGH IF RESET CONTROL IS HIGH

C. THE ÷ 10 OUTPUT WILL ALWAYS BE RESET TO HIGH STATE

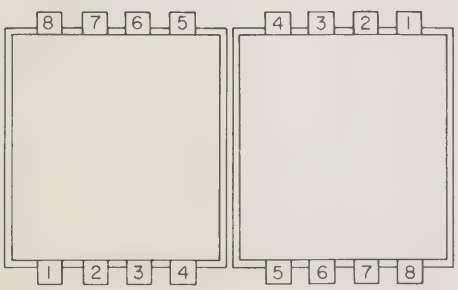
Figure 8-2. Integrated Circuit Diagram (Continued)



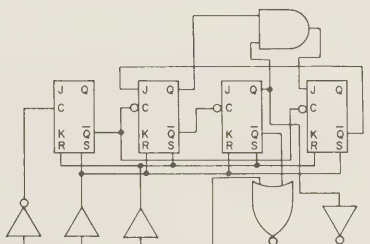
1820-0174
DUAL-IN-LINE PACKAGE (TOP VIEW)
POSITIVE LOGIC Y = A



1820-0198 AND 1820-0199
1820-0412, 1820-0413
1820-0226, 1820-0227
DUAL DECADE DIVIDER



1820-0412, & 1820-0413
1820-0226 & 1820-0227
DUAL DECADE DIVIDER



DECADE	CLOCK (COUNT) INPUT	RESET 0 INPUT	RESET 9 INPUT	GATE CONT	GATED OUTPUT	÷10 CARRY	V_{CC}	GND	HP PART NUMBER
A	2	1	16	14	13	4	15	3	1820-0198
B	10	9	8	6	5	12	7	11	1820-0199
	2	1	8	6	5	4	7	3	1820-0412 1820-0413
	2	1	16	14	13	4	15	3	1820-0226 1820-0227
PINS									

Figure 8-3

FLOW DIAGRAM FOR FREQUENCY MEASUREMENTS

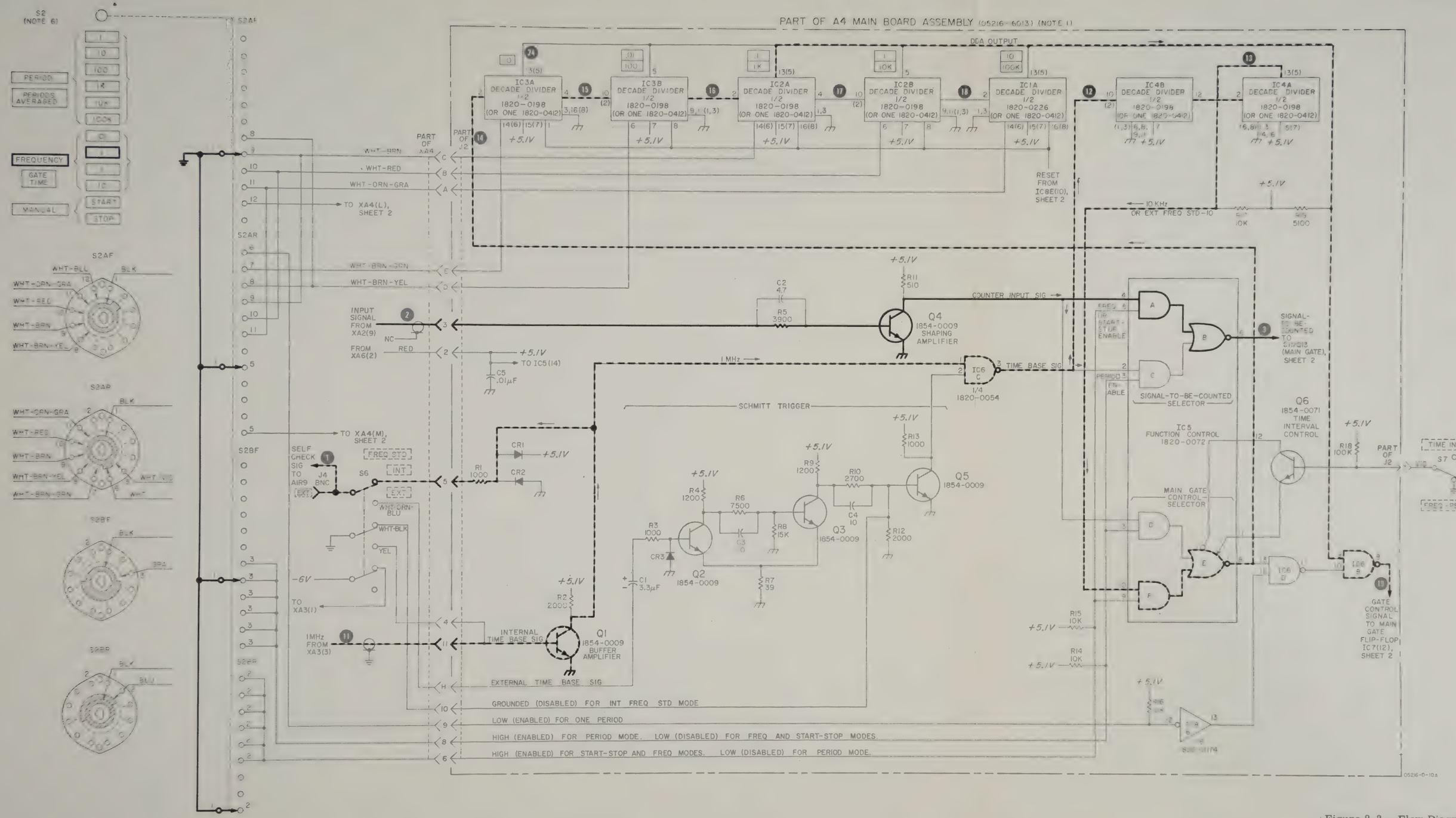


Figure 8-3. Flow Diagram for Frequency Measurements

Figure 8-4

FLOW DIAGRAM FOR PERIOD MEASUREMENTS

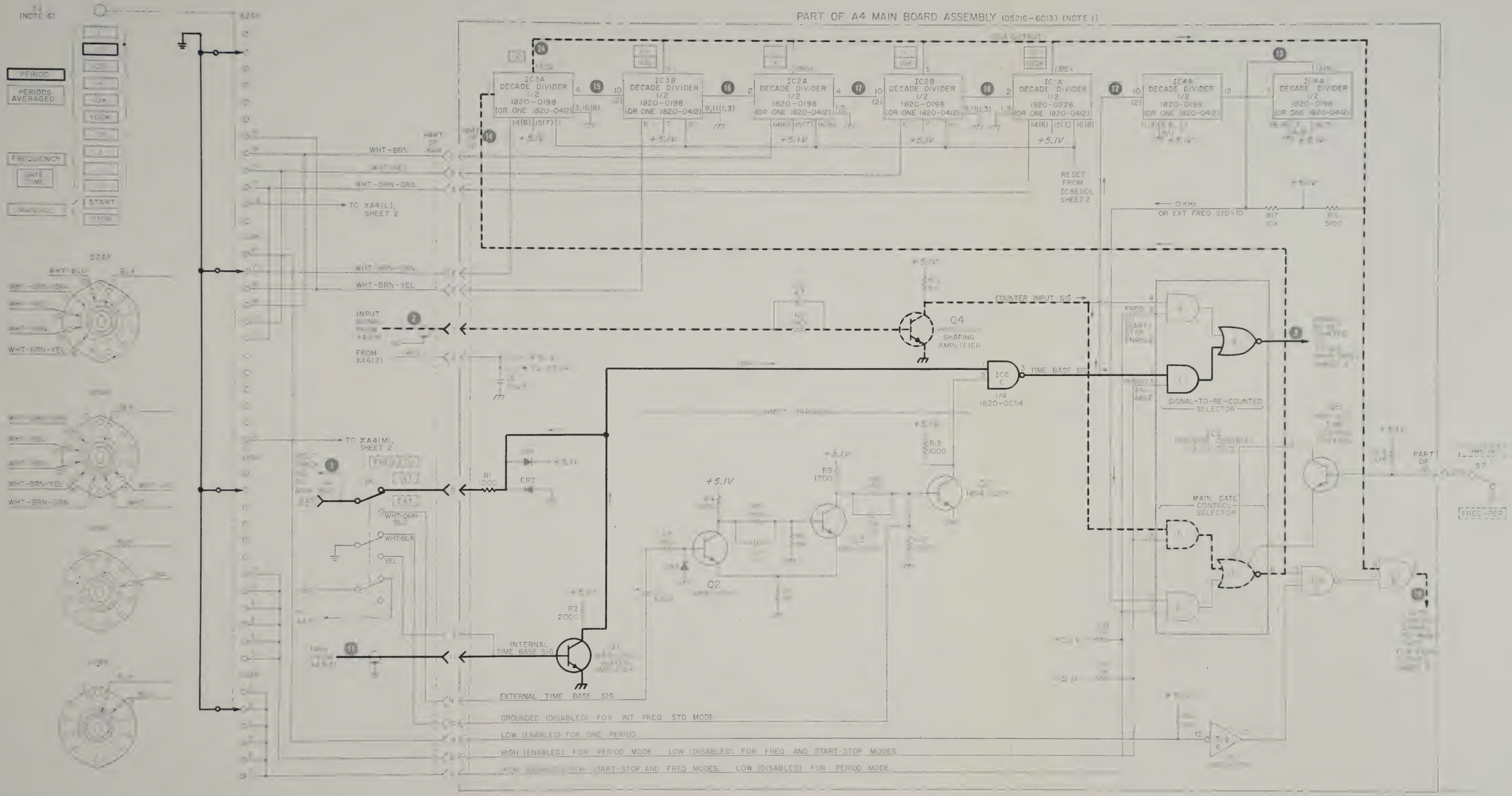


Figure 8-4. Flow Diagram for Period Measurements

Figure 8-5

FLOW DIAGRAM FOR RATIO MEASUREMENTS

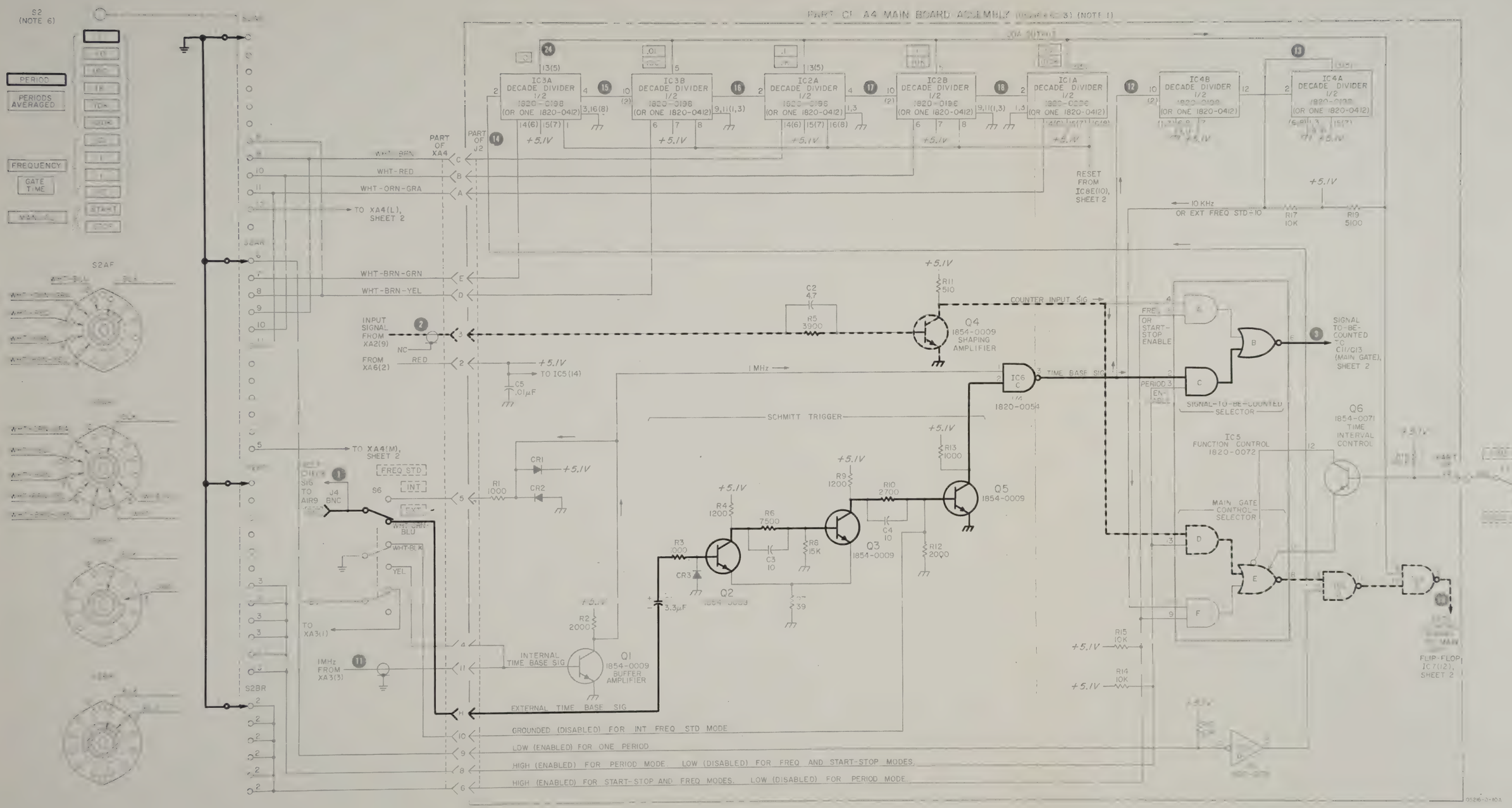


Figure 8-5. Flow Diagram for Ratio Measurements

Figure 8-6

FLOW DIAGRAM FOR TIME INTERVAL MEASUREMENTS

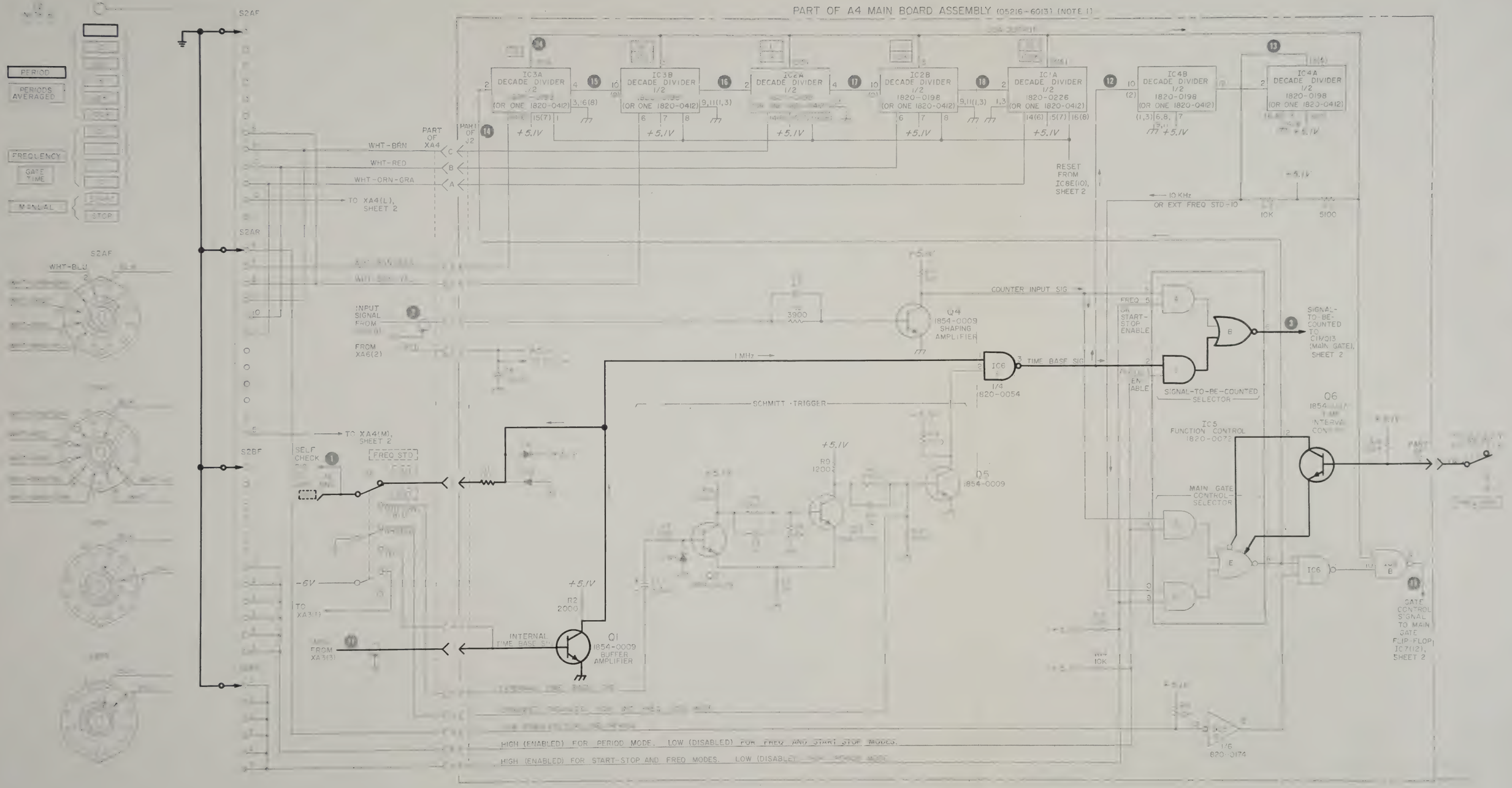
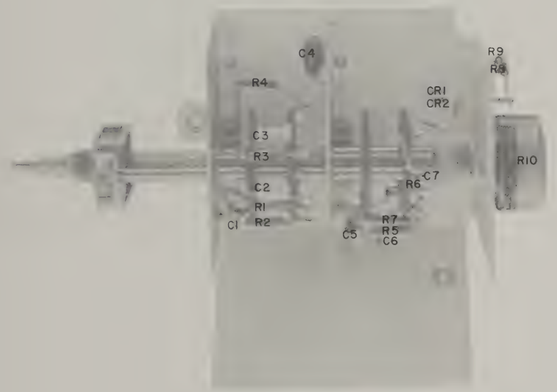


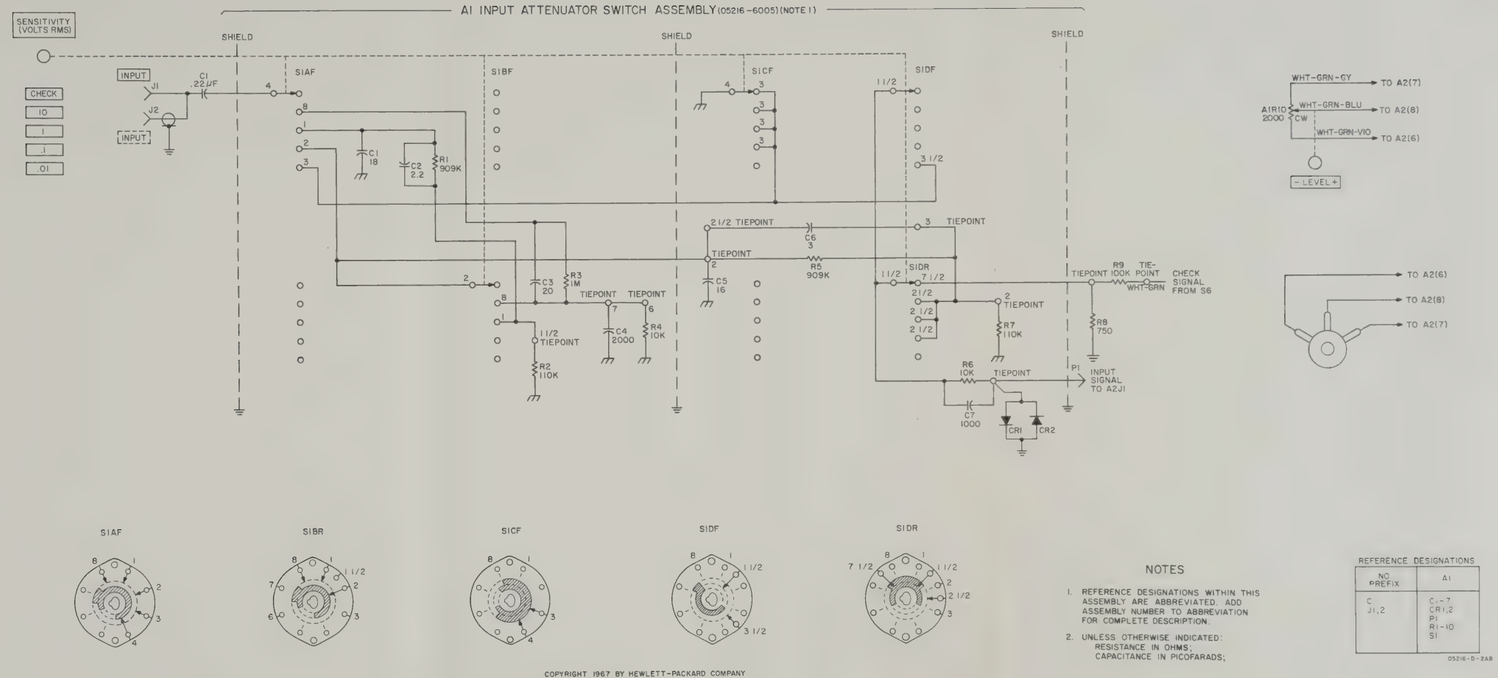
Figure 8-6. Flow Diagram for Time Interval Measurements

Figure 8-7
A1 INPUT ATTENUATOR



A1

02430-3



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

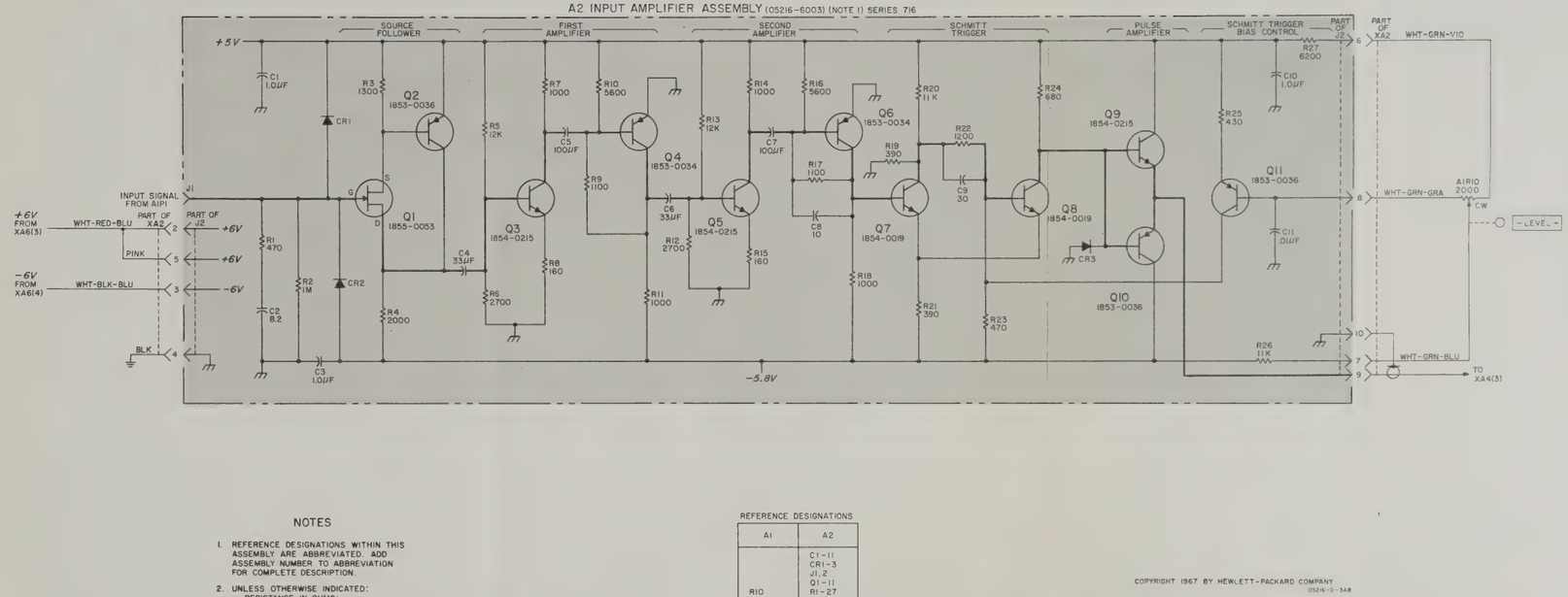
NO. PREFIX	A1
C	C-7
J1,2	CR1,2
	P1
	R1-10
	S1

05216-D-2A8

Figure 8-7. A1 Input Attenuator

Figure 8-8
A2 INPUT AMPLIFIER

A2



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

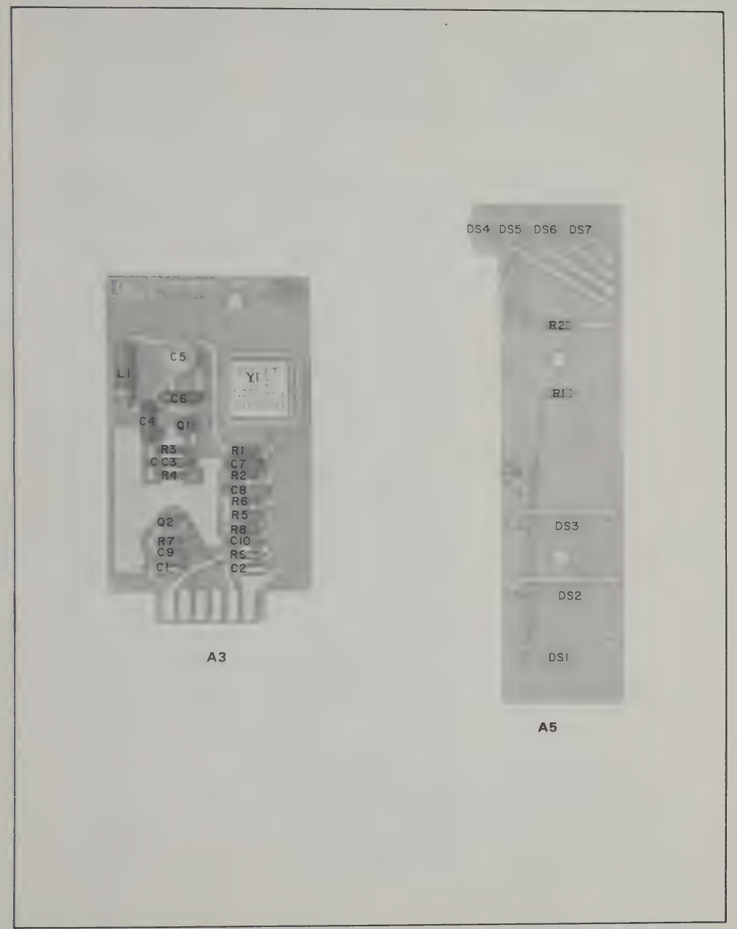
A1	A2
R10	C1-11 CR1-3 J1, 2 Q1-11 R1-27

Figure 8-8. A2 Input Amplifier

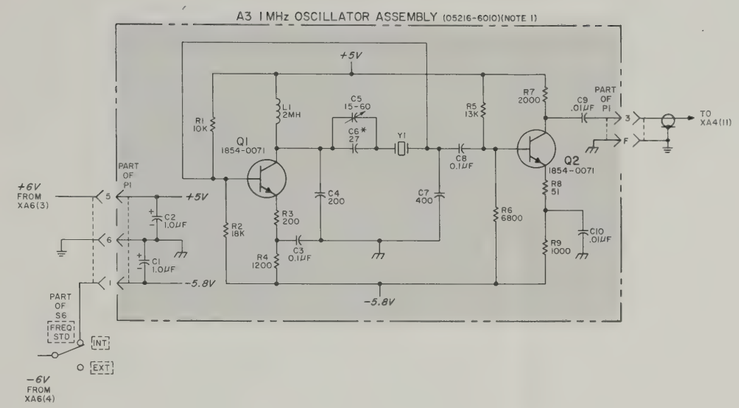
Figure 8-9

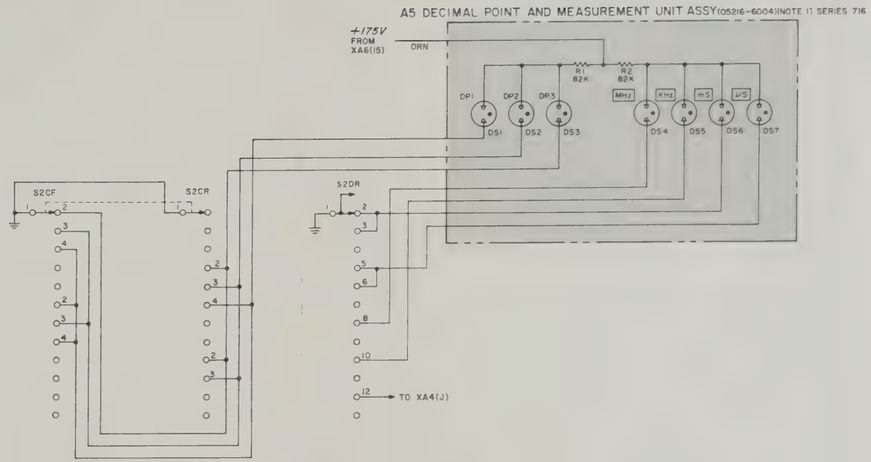
A3 10 MHz OSCILLATOR
A5 DECIMAL POINT AND MEASUREMENT UNIT

02430-3



02430-3



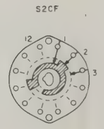


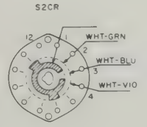
NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A3	A5
	C1-10	DS1-7
	L1	
	P1	
	Q1,2	
	R1-9	R1,2
S2		
	Y1	





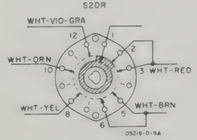
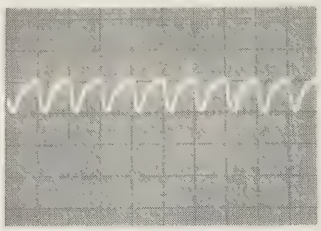
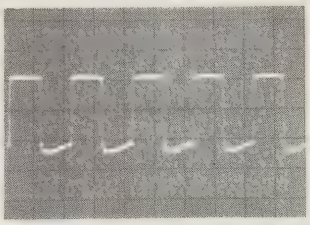


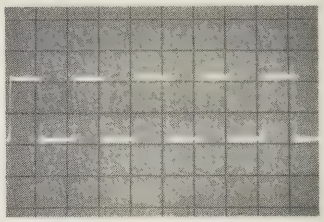
Figure 8-9. A3 10 MHz Oscillator
A5 Decimal Point and Measurement Unit



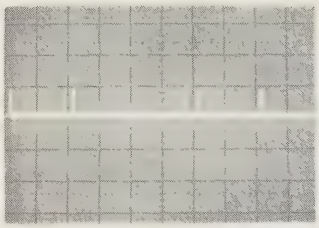
1 .5V/cm; 1 μsec/cm



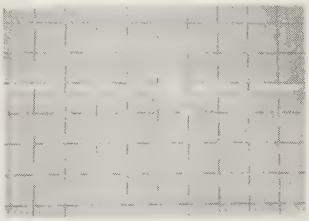
2 .2V/cm; .5 μsec/cm



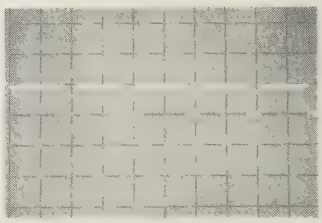
3 .2V/cm; 5 μsec/cm



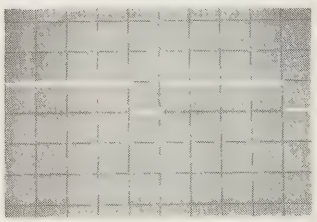
4 .5V/cm; .5 μsec/cm



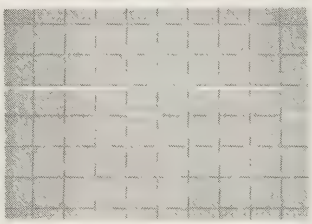
5 .5V/cm; 50 μsec/cm



6 .5V/cm; 0.5 msec/cm

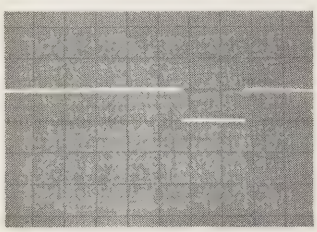


7 .5V/cm; 2 msec/cm

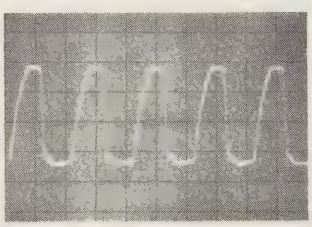


8 .5V/cm; 20 msec/cm

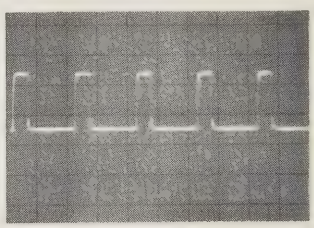
9 .5V/cm; 0.2 sec/cm



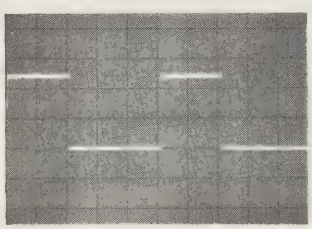
10 .5V/cm; 1 sec/cm



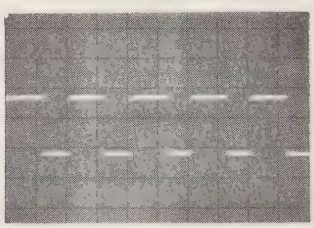
11 .2V/cm; .5 μsec/cm



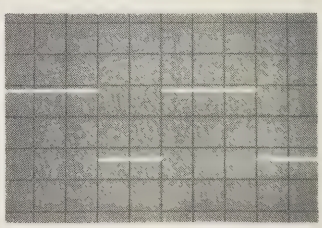
12 .2V/cm; .5 μsec/cm



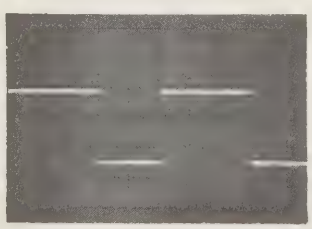
13 .2V/cm; .5 μsec/cm



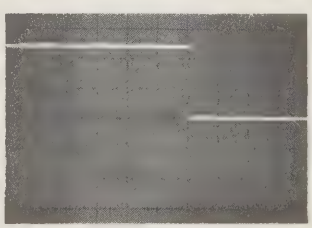
14 .2V/cm; .5 μsec/cm



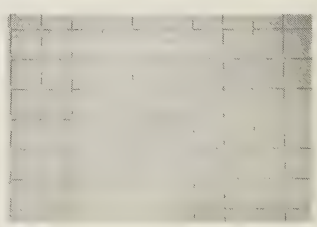
15 .2V/cm; .2 msec/cm



16 .2V/cm; 2 msec/cm



17 .2V/cm; 10 msec/cm



18 .2V/cm; .1 μsec/cm

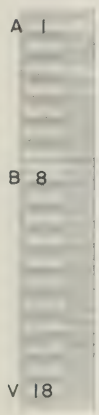
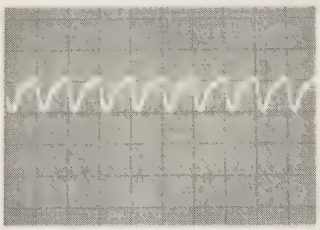
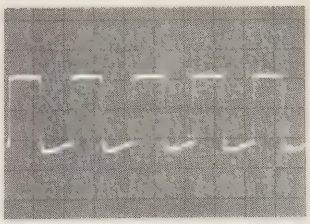


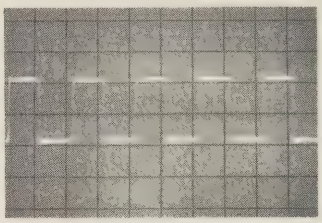
Figure 8-10
A4 MAIN BOARD
(Sheet 1 of 3)



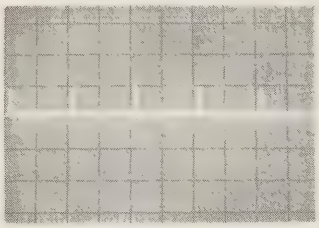
1 .5V/cm; 1 μsec/cm



2 .2V/cm; .5 μsec/cm

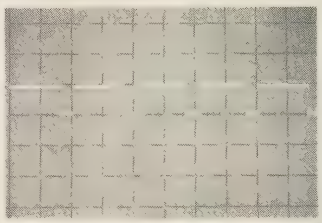


3 .2V/cm; 5 μsec/cm

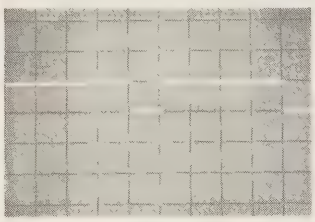


4 .5V/cm; .5 μsec/cm

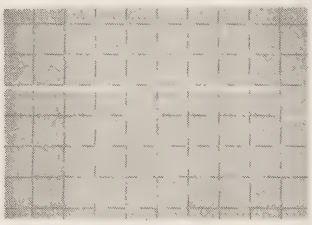
5 .5V/cm; 50 μsec/cm



6 .5V/cm; 0.5 msec/cm

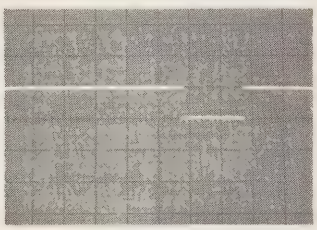


7 .5V/cm; 2 msec/cm

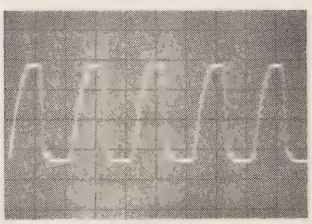


8 .5V/cm; 20 msec/cm

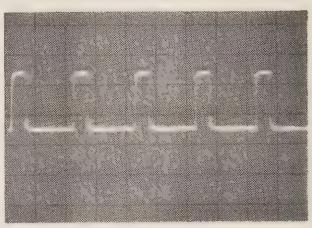
9 .5V/cm; 0.2 sec/cm



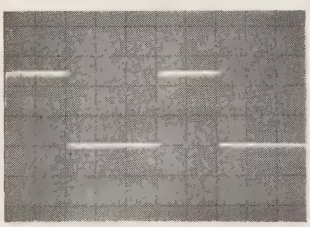
10 .5V/cm; 1 sec/cm



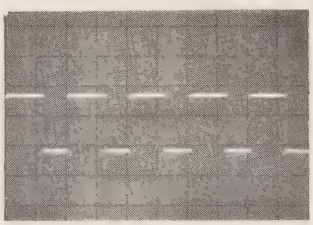
11 .2V/cm; .5 μsec/cm



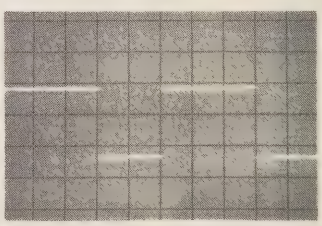
12 .2V/cm; .5 μsec/cm



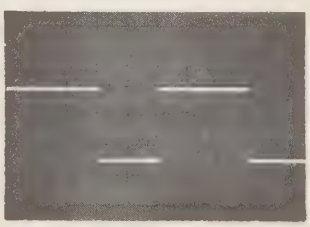
13 .2V/cm; .5 μsec/cm



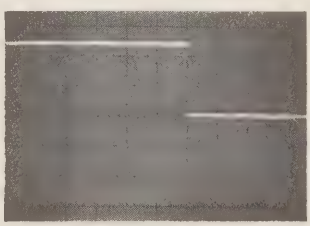
14 .2V/cm; .5 μsec/cm



15 .2V/cm; .2 msec/cm



16 .2V/cm; 2 msec/cm



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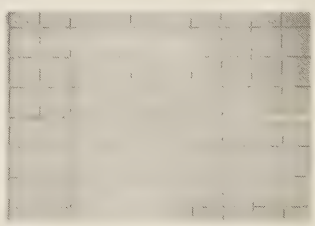
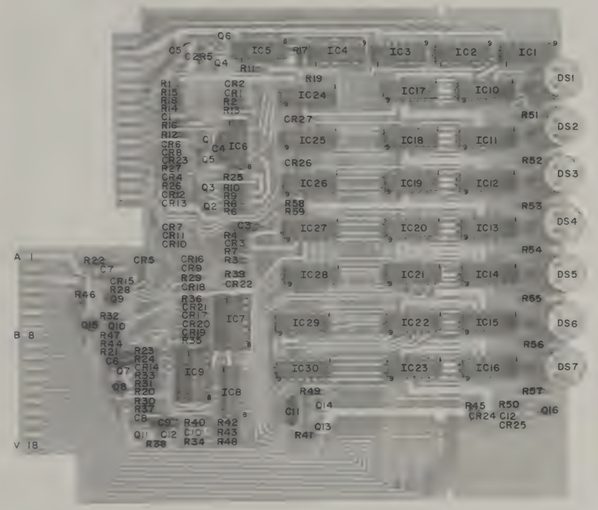
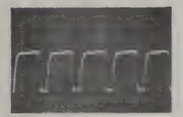


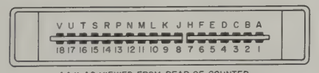
18 .2V/cm; .1 μsec/cm



A4



⑱ .2V/cm; .5 μsec/cm



A4J1 AS VIEWED FROM REAR OF COUNTER

02430-3

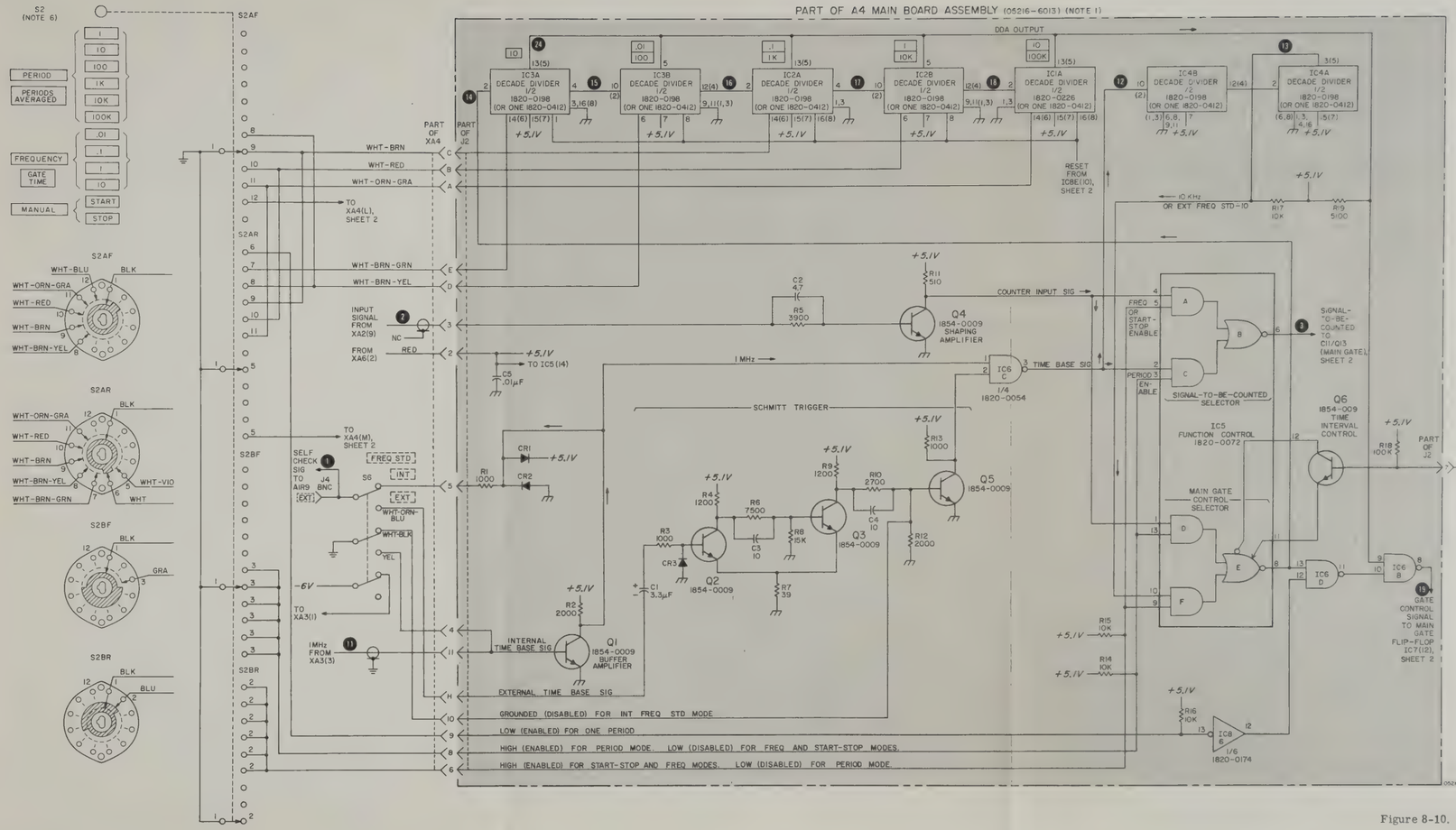
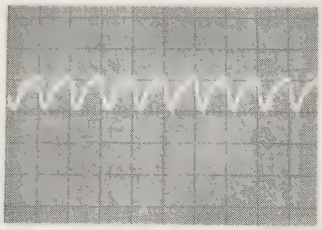
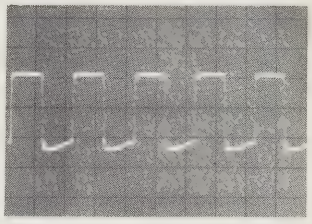


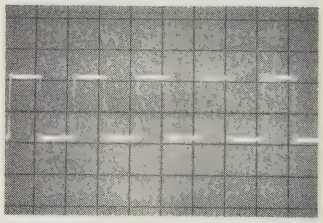
Figure 8-10. A4 Main Board (Sheet 1 of 3)



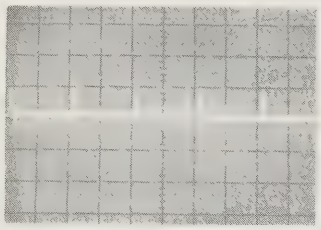
1 .5V/cm; 1 μsec/cm



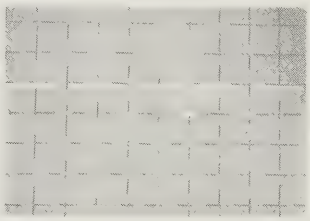
2 .2V/cm; .5 μsec/cm



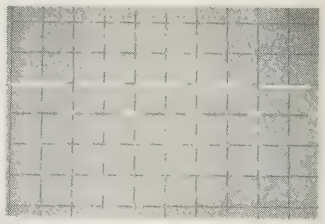
3 .2V/cm; 5 μsec/cm



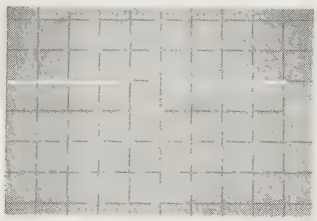
4 .5V/cm; .5 μsec/cm



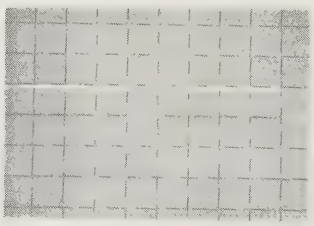
5 .5V/cm; 50 μsec/cm



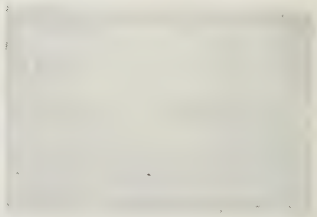
6 .5V/cm; 0.5 msec/cm



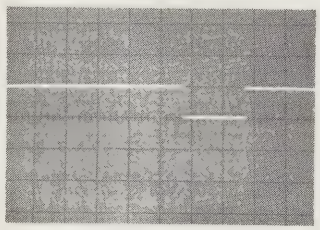
7 .5V/cm; 2 msec/cm



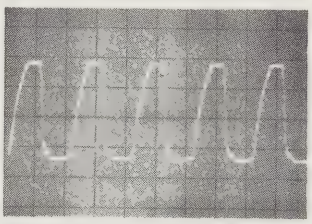
8 .5V/cm; 20 msec/cm



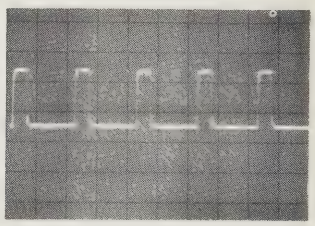
9 .5V/cm; 0.2 sec/cm



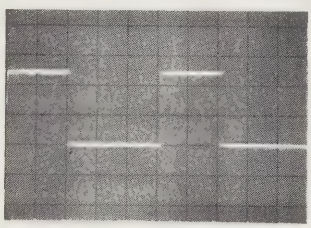
10 .5V/cm; 1 sec/cm



11 .2V/cm; .5 μsec/cm



12 .2V/cm; .5 μsec/cm



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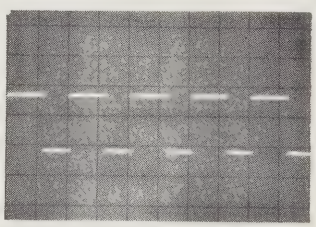
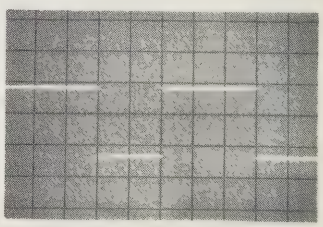
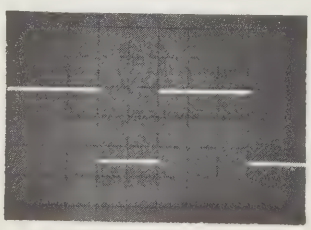


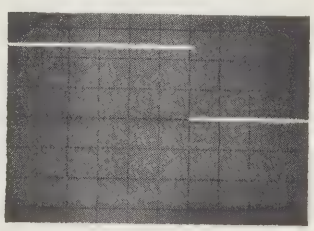
14 .2V/cm; .5 μsec/cm



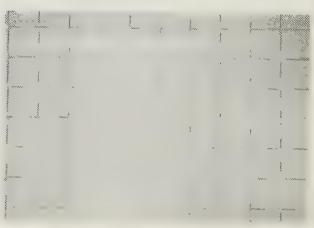
15 .2V/cm; .2 msec/cm



16 .2V/cm; 2 msec/cm



17 .2V/cm; 10 msec/cm



18 .2V/cm; .1 μsec/cm

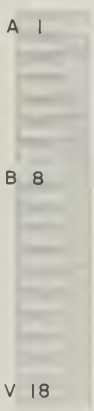
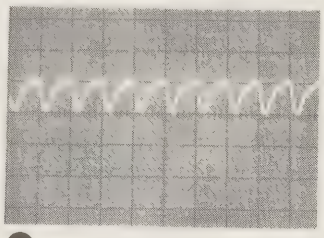
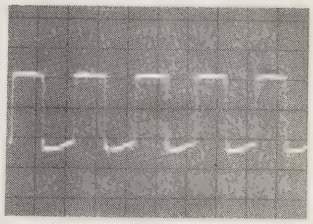


Figure 8-10
A4 MAIN BOARD
(Sheet 2 of 3)



1 .5V/cm; 1 μsec/cm



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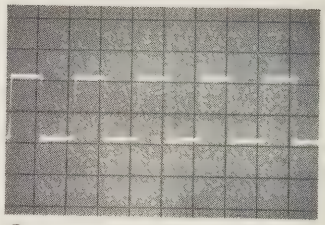
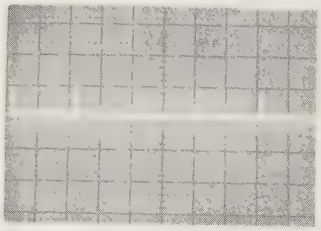
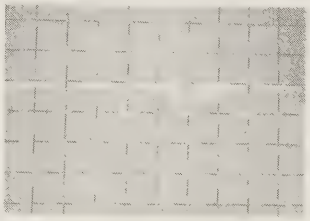


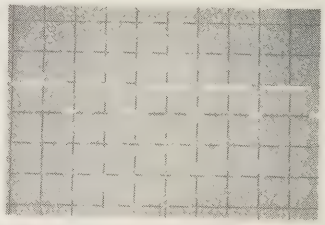
3 .2V/cm; 5 μsec/cm



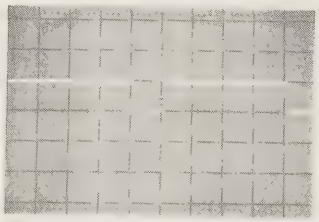
4 .5V/cm; .5 μsec/cm



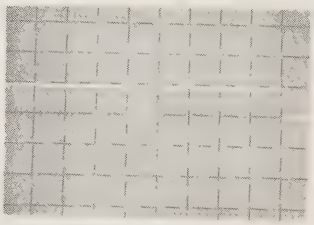
5 .5V/cm; 50 μsec/cm



6 .5V/cm; 0.5 msec/cm

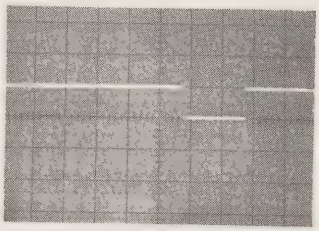


7 .5V/cm; 2 msec/cm

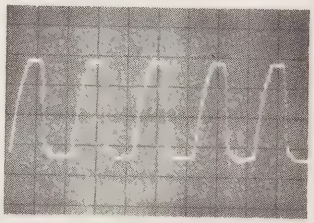


8 .5V/cm; 20 msec/cm

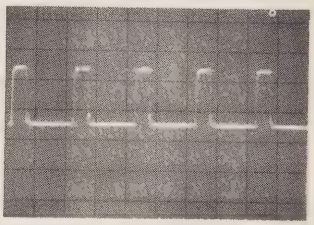
9 .5V/cm; 0.2 sec/cm



10 .5V/cm; 1 sec/cm



11 .2V/cm; .5 μsec/cm



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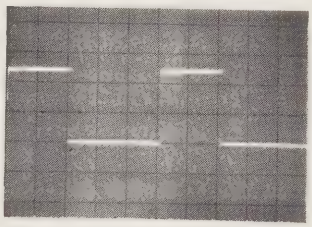
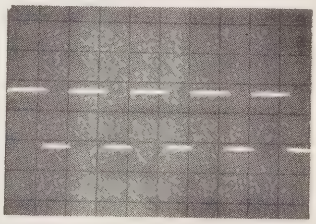
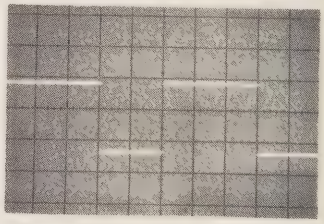


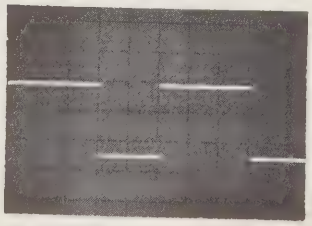
13 .2V/cm; .5 μsec/cm



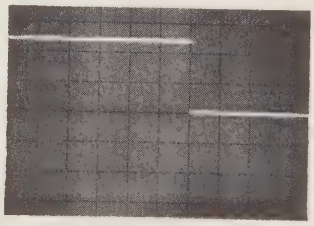
14 .2V/cm; .5 μsec/cm



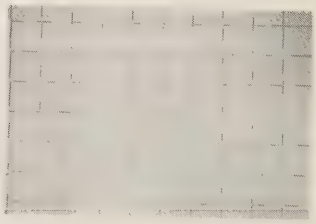
15 .2V/cm; .2 msec/cm



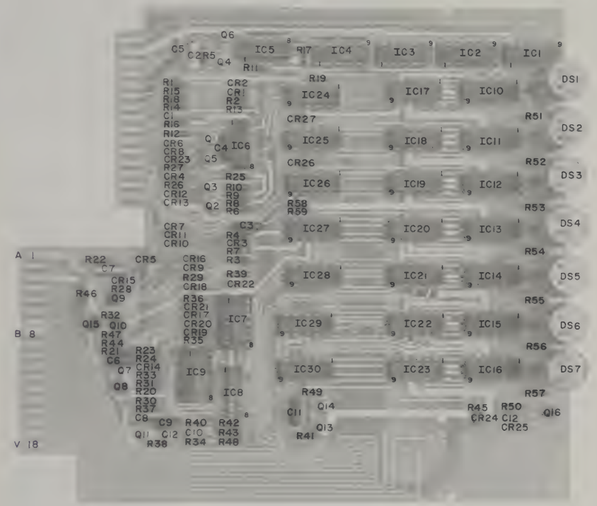
16 .2V/cm; 2 msec/cm



17 .2V/cm; 10 msec/cm

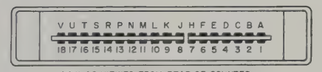


18 .2V/cm; .1 μsec/cm

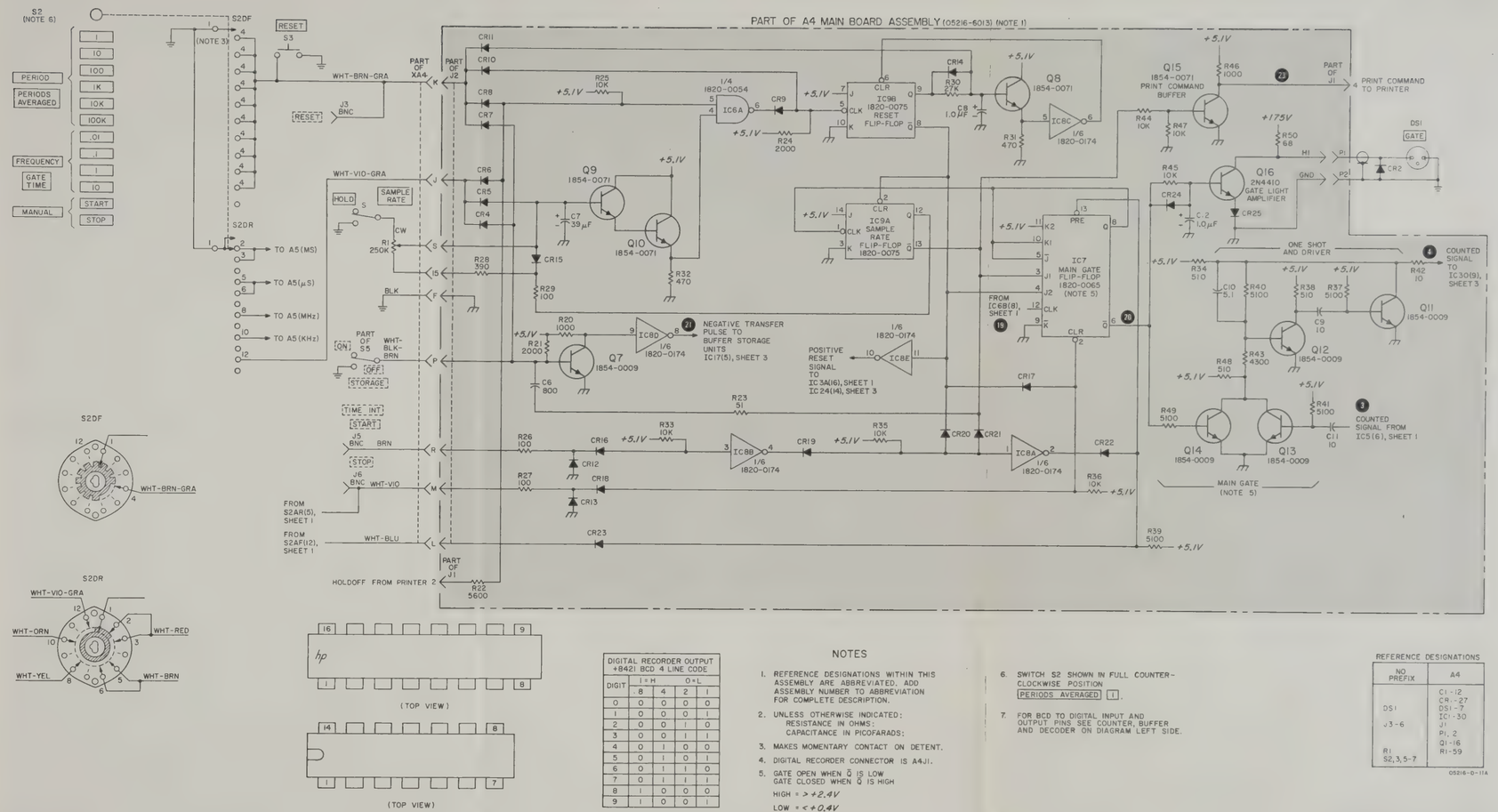


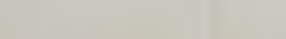
A4

⑮ .2V/cm; .5 μsec/cm



A4J1 AS VIEWED FROM REAR OF COUNTER





DIGITAL RECORDER OUTPUT +8421 BCD 4 LINE CODE				
DIGIT	1 = H			0 = L
	8	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

NOTES

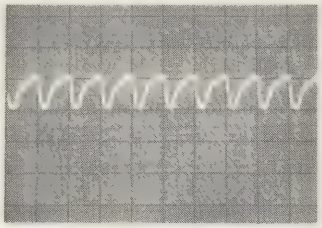
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;
3. MAKES MOMENTARY CONTACT ON DETENT.
4. DIGITAL RECORDER CONNECTOR IS A4J1.
5. GATE OPEN WHEN $\bar{Q}$ IS LOW GATE CLOSED WHEN $\bar{Q}$ IS HIGH
   HIGH = > +2.4V
   LOW = < +0.4V
6. SWITCH S2 SHOWN IN FULL COUNTER-CLOCKWISE POSITION PERIODS AVERAGED 1.
7. FOR BCD TO DIGITAL INPUT AND OUTPUT PINS SEE COUNTER, BUFFER AND DECODER ON DIAGRAM LEFT SIDE.

REFERENCE DESIGNATIONS

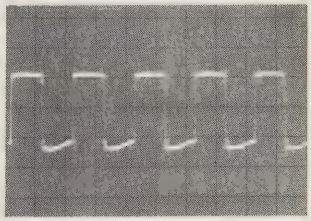
NO PREFIX	A4
DS1	C1-12
J3-6	CR1-27
	DS1-7
	IC1-30
	J1
R1	P1, 2
S2, 3, 5-7	Q1-16
	R1-59

05216-D-11A

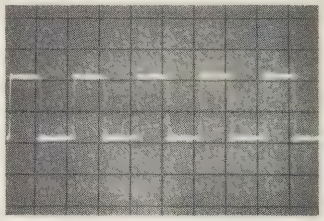
Figure 8-10. A4 Main Board (Sheet 2 of 3)



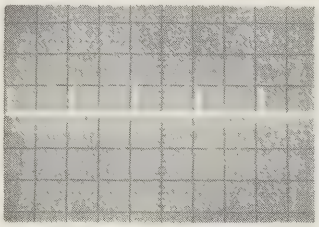
1 .5V/cm; 1 μsec/cm



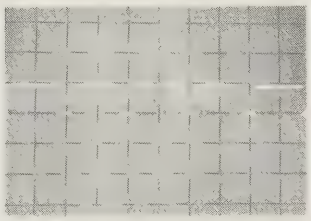
2 .2V/cm; .5 μsec/cm



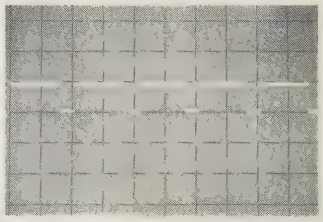
3 .2V/cm; 5 μsec/cm



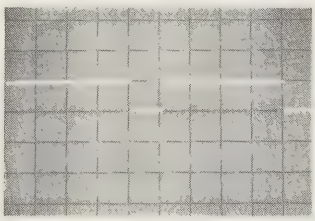
4 .5V/cm; .5 μsec/cm



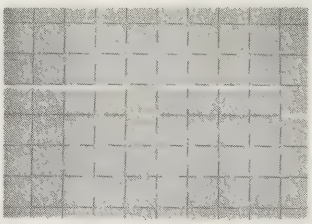
5 .5V/cm; 50 μsec/cm



6 .5V/cm; 0.5 msec/cm

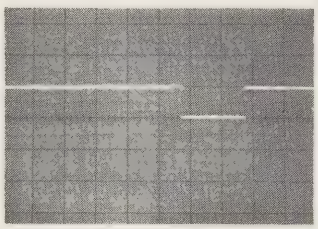


7 .5V/cm; 2 msec/cm

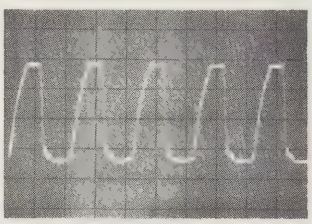


8 .5V/cm; 20 msec/cm

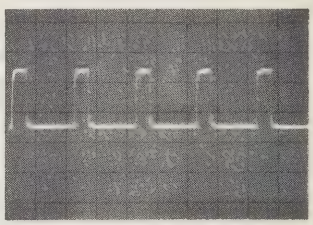
9 .5V/cm; 0.2 sec/cm



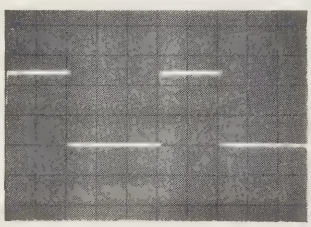
10 .5V/cm; 1 sec/cm



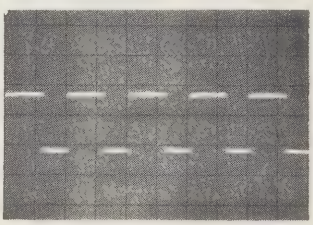
11 .2V/cm; .5 μsec/cm



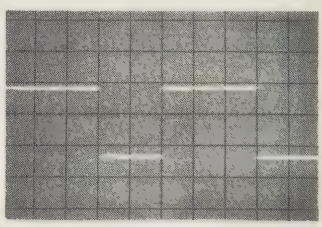
12 .2V/cm; .5 μsec/cm



13 .2V/cm; .5 μsec/cm

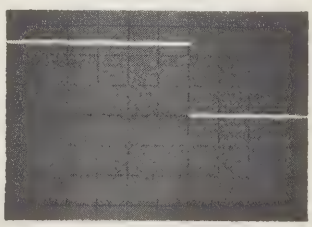


14 .2V/cm; .5 μsec/cm

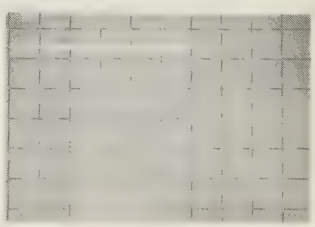


15 .2V/cm; .2 msec/cm

16 .2V/cm; 2 msec/cm



17 .2V/cm; 10 msec/cm



18 .2V/cm; .1 μsec/cm

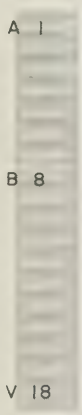
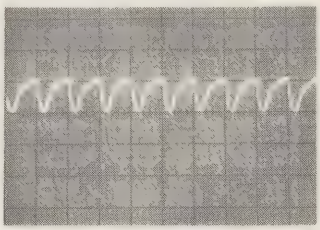
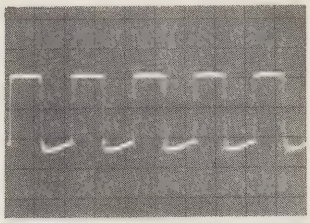


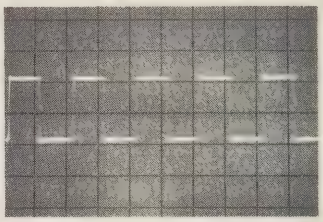
Figure 8-10
A4 MAIN BOARD
(Sheet 3 of 3)



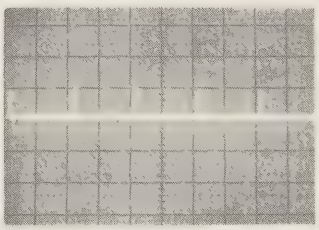
1 .5V/cm; 1 μsec/cm



2 .2V/cm; .5 μsec/cm

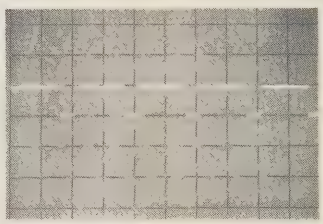


3 .2V/cm; 5 μsec/cm

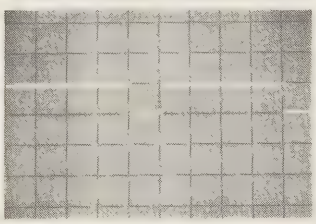


4 .5V/cm; .5 μsec/cm

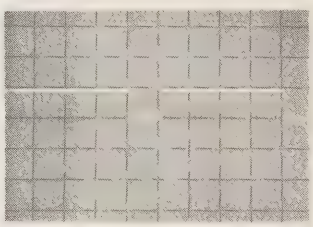
5 .5V/cm; 50 μsec/cm



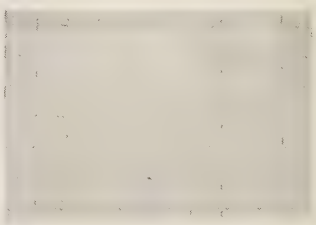
6 .5V/cm; 0.5 msec/cm



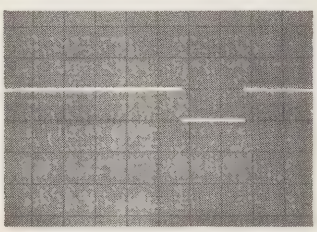
7 .5V/cm; 2 msec/cm



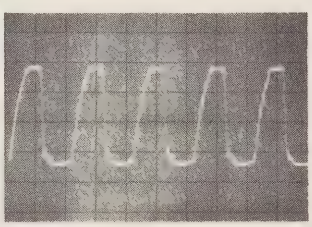
8 .5V/cm; 20 msec/cm



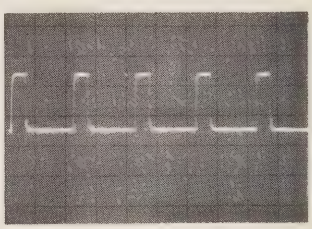
9 .5V/cm; 0.2 sec/cm



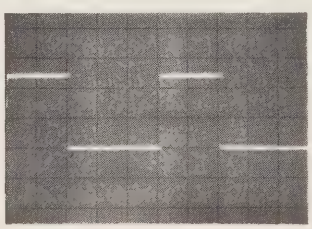
10 .5V/cm; 1 sec/cm



11 .2V/cm; .5 μsec/cm



12 .2V/cm; .5 μsec/cm



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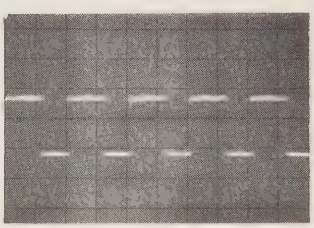
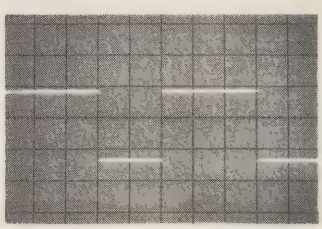
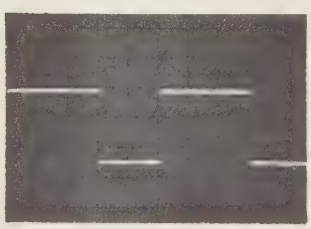


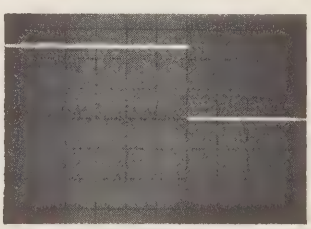
14 .2V/cm; .5 μsec/cm



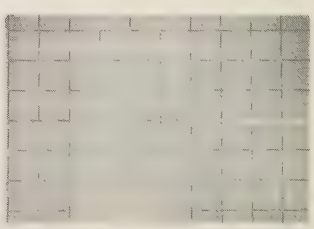
15 .2V/cm; .2 msec/cm



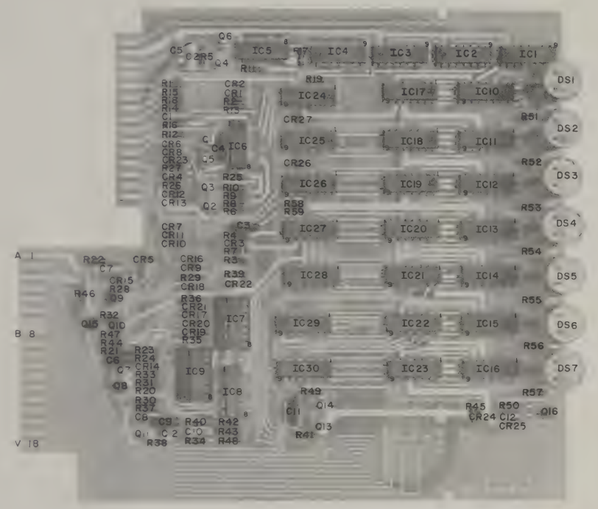
16 .2V/cm; 2 msec/cm



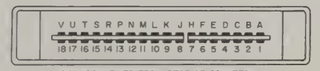
17 .2V/cm; 10 msec/cm



18 .2V/cm; .1 μsec/cm



⑱ .2V/cm; .5 μsec/cm



A4J1 AS VIEWED FROM REAR OF COUNTER

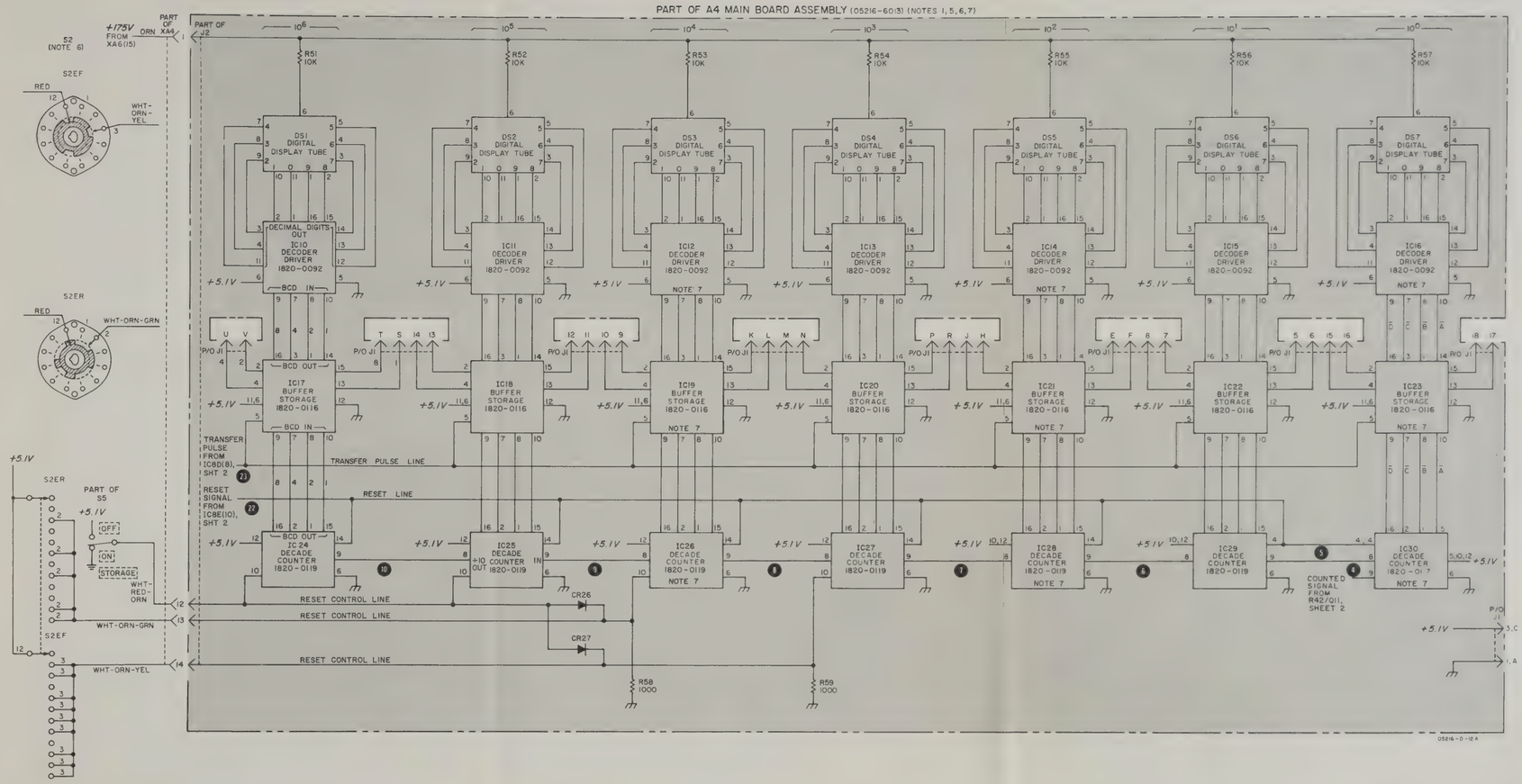
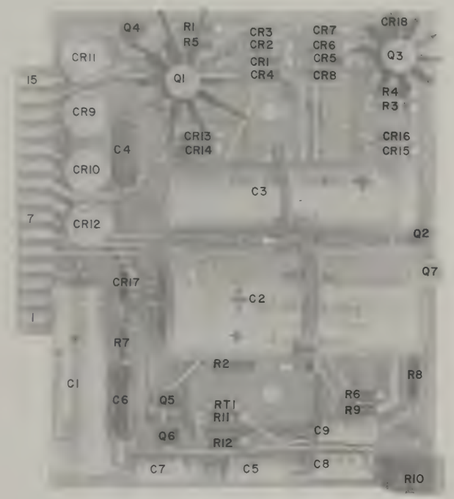


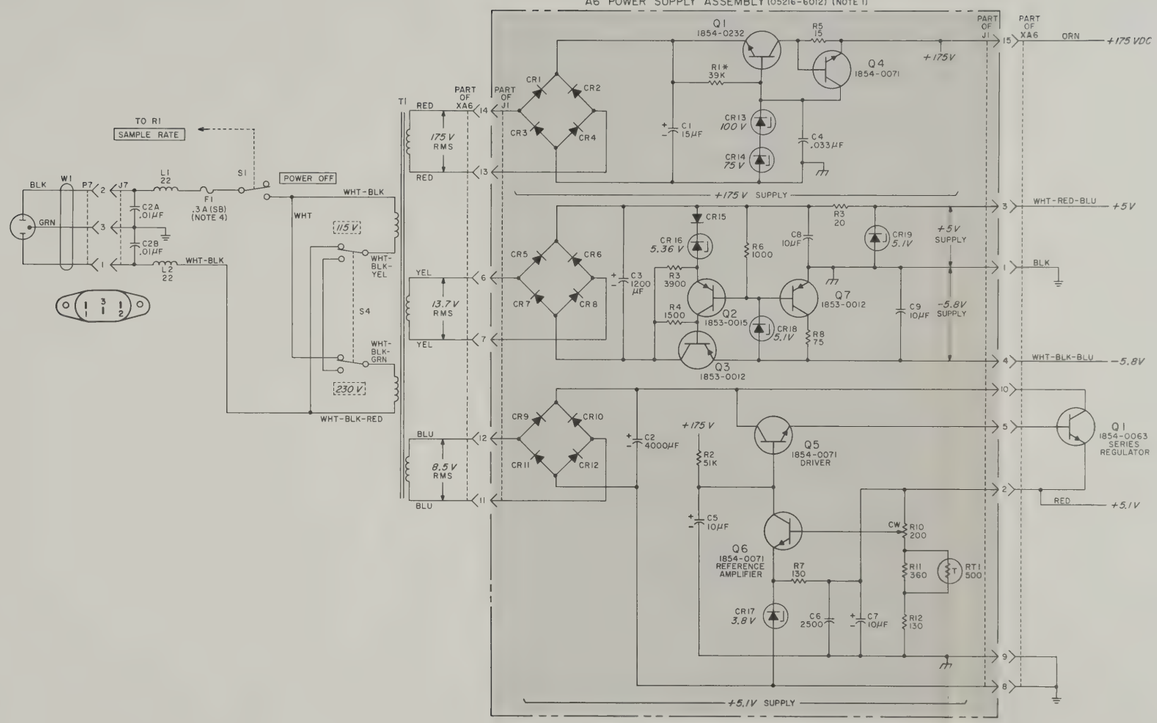
Figure 8-10. A4 Main Board
(Sheet 3 of 3)

Figure 8-11
A6 POWER SUPPLY



A6

02430-3



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. FOR 230 V OPERATION SWITCH S4 TO 230 V POSITION CHANGE F1 TO .15A (SB)

REFERENCE DESIGNATIONS

NO PREFIX	A6
C2	C-9 CR1-19
F1 -7	J-
L1, 2	
P7	
Q1	Q1-7 R1-2 RT1
S1, 4	
T-	
W1	

052 6-D-13A

Figure 8-11. A6 Power Supply

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Model: 5216A Serial Number: 976-03572 Date Shipped: DEC 8 1970

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MANUAL CHANGES

MODEL 5216A
ELECTRONIC COUNTER

Manual Serial Prefixed: 948-
Manual Printed: MARCH 1970

MAKE ALL CORRECTIONS IN THIS MANUAL ACCORDING TO ERRATA BELOW, THEN CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (3 DIGITS) OR SERIAL NUMBER (8 DIGITS) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

► NEW ITEM.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
976-	1

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

ERRATA

Page 6-2, Table 6-1:
Change A1R6 to "0683-1015 R: FXD COMP 100 OHM 5% 1/4W".
Add A1R11 0683-1015 R: FXD COMP 100 OHM 5% 1/4W.
Change: A1CR1 to 1901-0376 Diode Silicon.
A1CR2 to 1901-0376 Diode Silicon.
Delete: A2CR1 1901-0040 Diode Silicon.
A2CR2 1901-0040 Diode Silicon.
Change A2R9 to 0757-0927 R: Fxd Flm 1.3K ohm 2% 1/8W.
A2R20 to 0683-1035 R: Fxd Comp 10K ohm 5% 1/4W.
A2R27 to 0698-3166 to R: Fxd Film 6.48K 2% 1/8W.

Page 6-3, Table 6-1:
Change A4CR14 to "1901-0040, Diode: Silicon 30 Ma 30 WV".

Page 6-4, Table 6-1:
Change A4Q6 to "1854-0071".

Page 6-8, Table 6-2:
Change: 0757-0925 TQ to 1.
0757-0927 TQ to 2.
0683-1015 R: Fxd Comp 100 ohm 5% 1/4W TQ to 4.
0683-1035 R: Fxd Comp 10K ohm 5% 1/4W TQ to 21.
Delete: 0757-0943 R: Fxd Flm 6.2K ohm 2% 1/8W.
Add: 0698-3166 R: Fxd Flm 6.48K ohm 1% 1/8W, Mfr. 91637, Mfr. Part No. CMS1-1-10-32, TQ 1.

Page 6-9, Table 6-2:
Change: 1901-0040 Diode, Silicon 30 MA 30 wV TQ to 7.
Add: 1901-0376 Diode, Silicon Mfg. 07933, Mfg. Part No. RD5288, TQ 2.

Page 8-15, Figure 8-7:
Change A1R6 to 100 ohms.

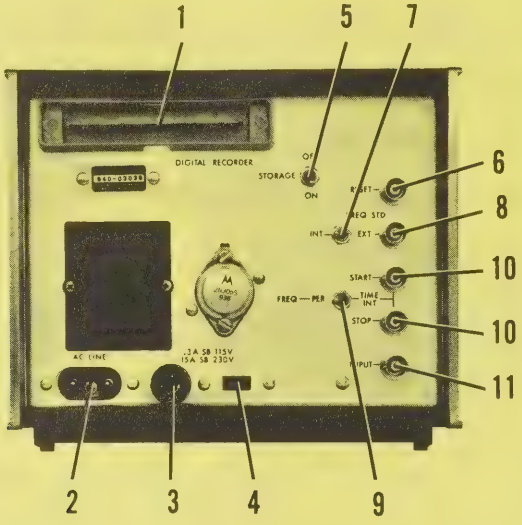
Page 8-17, Figure 8-8, A2 Input Amplifier Schematic:
Change: R1 to 430.
R9 to 1300.
R20 to 10K.
R27 to 6480 Ω.
All "+6V" to "+5V" and all "-6V" to "-5.8V".
Delete CR1 and CR2.
Same page in photograph:
Delete: CR1 and CR2.
Change: Designation of component between R9 and R11 to R26.

ERRATA (Cont'd)

Page 8-19, Figure 8-9:
Change: On A3P1(5) "+6V from XA6(3)" to +5V from XA6(3)".
On A3P1(1) "-6V from XA6(4)" to "-5.8V from XA(4)".
Change: "10 MHz" in title to "1 MHz".

Page 8-21, Figure 8-2:
Change Q6 type to "1854-0071".

Page 3-3, Figure 3-2:
Replace photo with Figure 1 below



► CHANGE 1 (976-)

Change 1 modifies the counter to comply with IEC (International Electrotechnical Commission) recommendations for primary power wiring. This change affects the detachable power cord, rear panel, rear panel power receptacle, 115V fuse, and 115V-230V sliding switch.

Page 1-1, Table 1-1:
Change power cord description to:
Detachable power cord 7-1/2 feet (231 cm) long CEE female connector and NEMA male connector HP Part No. 8120-1348.

Page 6-5, Table 6-1:
Delete F1 2110-0018 FUSE CARTRIDGE 0.25 AMP SLOW BLOW.
Add F1 2110-0033 FUSE CARTRIDGE 0.30 AMP SLOW BLOW.
Delete J7 1251-0148 CONNECTOR: POWER 3 PIN MALE.
Add J7 1251-2357 CONNECTOR: POWER 3 PIN MALE.

Page 6-6, Table 6-1:
Delete S4 3101-0033 SWITCH: SLIDE DPDT 0.5A 125AC/DC.
Add S4 3101-1234 SWITCH: SLIDE DPDT 125AC/DC.
Delete W1 8120-0078 CABLE ASSY: POWER CORD.
Add W1 8120-1348 CABLE ASSY: POWER CORD.

Page 6-7, Figure 6-1:
Change Rear Panel Part No. to 05216-0009.

Page 6-8, Table 6-2:
Change 1251-0148 to 1251-2357.
Change Mfr. No. to 82389.
Change Mfr. Part No. to EAC-301.

CHANGE 1
(Cont'd)

Page 6-9, Table 6-2:
Change 8120-0078 to 8120-1348.
Change Mfr. No. to 7093.
Change Mfr. Part No. to KHS-7041.
Change 05216-0004 to 05216-0009.
Change Mfr. Part No. to 05216-0009.

Figure 2, attached primary power supply schematic, (refer to Page 8-27, Figure 8-11) show circuit revisions.

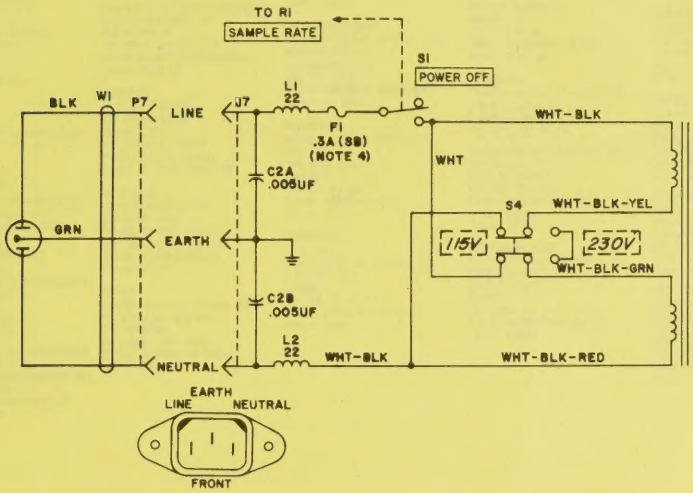


Figure 2

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